

## Chapter 8

# Question Co-Construction in VMT Chats

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**Abstract:** In an online collaborative context like VMT chats, questions are often not simple, well-defined queries for information, but should be understood as situated moves within the group dynamic of the problem-solving effort. The object of the questioning is itself an emergent property of the interaction, through which the meaning is successively interpreted, refined and converged upon by the details of how the question is built, read and responded to. Questioning can play an integral role in the social relations among the participants, either positioning individuals as more or less competent or else maintaining peer standings. Question/response interactions are key to pursuing group problem-solving strategies, building a joint problem space and sustaining the team discourse. In this chapter, we analyze a questioning episode in which the social aspects are particularly clear and interesting, and where the details of the questioning have dramatic consequences for the group process.

**Keywords:** Questioning, information behavior, situated expertise, participation

## Chat Questioning and Math Competence

In the VMT Project we invited students to come to chat with their peers in small groups about non-routine math problems designed for them that we thought might be interesting and might encourage mathematical thinking. Different from tutoring sessions, VMT chats stress peer interaction among students and collaboration working on a math problem. Usually a moderator is present in a chat session to explain what the group is expected to do, but not to give the group math help. The moderator remains in the session mainly to address logistical and technical issues. It

is up to the student team itself to organize its own interaction and discuss the math problem. While a general math topic is given, including several issues to explore, the students must to a large extent define the questions they will pursue.

We all know that competence in a particular matter is not always distributed equally among participants in an interaction. The chat setting makes the study of this distribution possible because subtle displays of one's own competence or of attitudes toward the competence of another that are possible through body language in face-to-face settings must be made more explicit online. In VMT, some groups may consist of students from different grade levels; participants may or may not have experience in prior VMT sessions; some may have looked at the problem and tried to solve it before they joined the chat while others have not. In terms of competencies, we notice that some students display higher mathematical fluency, e.g. working with equations; some are better at verbally expressing themselves while others are better at conceptualizing problems visually. Even though many of the differences in expertise, talent, ability, knowledge, understanding, etc. may exist, not all of them are made relevant to the interaction. Differences only become relevant to the organization of participation in the group when they are made so by participants—which can be done in a variety of ways. In other words, it is the local and situated differences that are of interactional relevance. The issue of relative competence often interacts with the student questioning processes.

This chapter explores how it is possible to sustain a productive peer relationship in an online group when there are relevant differences among actors in expertise, talent, ability, knowledge, or understanding. Pursuing this line of inquiry allows us to look into the mechanisms underlying peer-group interaction. How such *group mechanisms* may support or inhibit *individual learning* has become an important topic for current research on learning and instruction (Barron, 2003; Cohen et al., 2002; Schwartz, 1995). When there are differences in competence, actors need to work out among themselves the social order and the organization of their interaction. In this chapter, we look at how differences are attended to by participants in a collaborative peer group as part of the mechanism by which a group of students collaborate and manage the organization of their participation in ongoing chat interaction around problem solving. In particular, we examine the ways members of a small group (a) introduce differences in situated competencies as interactionally relevant, (b) organize their interaction to attend to these differences and (c) effect repairs where possible or find ways to proceed where repair is ineffective.

There are many ways that differences in competency can be introduced as interactionally relevant. Posing a question is often one way of accomplishing this. For example, an actor can ask a question about what is going on, or indicate there is a problem of understanding, or the actor can show the need for assistance by taking a particular kind of “next step” in a sequentially unfolding set of actions, etc. Acting as less competent than others does not mean the actor is not “membered” (Garfinkel & Sacks, 1970) as a participant in the ongoing interaction. It means the actors have constituted as relevant a particular difference in the distribution of presumed or actual competence among themselves. When a questioner asks certain kinds of questions, she constitutes and makes relevant differences in expertise, knowledge,

etc. as a matter for the recipients to attend to. Thus, not only is the questioner asking a recipient about the matter at hand, she is also instantiating their relationship in terms of the organization of their participation in the interaction (e.g., as questioner and answerer). In examining our data of students' interaction in VMT chats, we have noticed that *question-response pairs* are frequently invoked for attending to differences in local expertise and competency. For instance, asking a question may imply that the addressee(s) are likely to be able to provide some information that the questioner does not know.

When actors put forward certain questions that do not address explicitly their standing as participants in the interaction, matters of difference in knowledge, understanding, expertise, etc., can be addressed in ways that preserve a peer relationship between questioner and respondent. When actors make the organization of participation explicit in the question-response construction as a matter to be addressed, then the nature of the relationships among interactants becomes a matter of concern that needs to be addressed. Issues of differences in knowledge, understanding, expertise, etc., are then made relevant in terms of the way those relationships are worked out.

Thus, one way that actors maintain peer relationships is by not addressing potential differences in competence explicitly as an interactional issue in question-response interactions. In this chapter, we show how actors *build a question and build a response* that allows the questioner and the respondent to attend to their relationship by addressing the matter at hand rather than by explicitly mentioning their relationship itself. Through the data analysis we present, we illustrate how we came to understand this.

## **The Context of the Case Study**

The data consists of excerpts taken from chat sessions of Team C in the VMT Spring Fest 2006. This event featured teams who participated in four consecutive sessions over a two-week period. During the four sessions, there were some changes in the membership of some groups. For example, Team C had a newcomer joining at the beginning of the second session but a participant of the first session did not return. Teams were given the same set of problems, which initially required that they find the patterns of growth for a certain shape of stacked squares made up of sticks. In later sessions, the teams made their own shapes using squares and sticks and explored the pattern of growth of the number of squares and sticks in these shapes.

The first part of Team C's work that we analyze is from the first of the four sessions. It includes one episode that is split in six excerpts and two complimentary short excerpts from later in the session. Nish is a latecomer who joined about 10 minutes after other participants began working on the problem. Prior to Nish's arrival, the other three participants had worked out formulas to describe the pattern of growth for the number of sticks. Thus, when Nish arrived, the other participants were busy discussing their formulas. The moderator made two requests asking the group to bring Nish up to speed, the first of which did not receive much attention

from the group members, who were engaged in their task at hand. In response to the second request from the moderator, two participants, Jason and David, gave Nish brief instructions on how to reload the previous messages in the chat room. David also provided a summary of their findings, including how they found out the pattern of the number of squares and the number of sticks. They then moved on with the task they were engaged in, which was to write up their findings and post those findings on a wiki to share with other teams. The excerpts we analyze here start about 10 minutes after Nish joins the chat.

## Making Differences Relevant: Question Construction

In a peer group engaged in math problem solving, competence—either in doing math, in being a member, or in other matters—is not always equally distributed among participants in an interaction. When differences in competencies become relevant matters among participants, participants use conventional methods to attend to those differences. Indicating a problem of understanding like Nish did at the beginning of the episode (see Log 8-1) or asking a question are among those methods to introduce differences as interactionally relevant. We analyze the excerpt in Log 8-1 to show how a particular method is used by participants to make differences relevant to the ongoing interaction. When a member of a peer group explicitly puts forward the issues regarding actors’ participation such as competency, discussion on such issues may be avoided by participants. This allows the peer relationship to be preserved. The excerpt illustrates how Nish’s posting at line 126 brings interactional trouble for the participants and how a *question* is constructed through the interaction.

*Log 8-1.*

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126	06.45.11	Nish	just to clarify sumthing, i am not overwhelmingly good at math as u guys seem to be, so it may take me more time than u guys to understand sumthing..
127	06.45.44	Moderator	can you tell us what's puzzling you?
128	06.46.07	Jason	are we allowed to post images on the wiki? I could just download TeX real quick and get the summation notation in a small graphic
129	06.46.12	Nish	the derivation of the number of squares

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At line 126, Nish produces a report in which he (a) offers a self-assessment of his own math competency and (b) appends to this a description of his performance and participation in the ongoing activity of the assembled participants as a consequence of this difference. The fact that this report is a self-assessment made by Nish and the organization of participation is explicitly referenced in it (“**so it may take me more time than u guys to understand sumthing.**”) may have made Nish’s posting a problematic matter for the participants. It reifies knowledge relations among participants in that the self-assessment is produced by making comparison of oneself to other actors among the group as a collectivity. The report calls on members of the collectivity to organize their participation to address the issues—i.e., differences among actors made relevant within it—which involves a discussion about one of the actors rather than about a

mathematical matter. This problematic nature of the matter is underscored by the fact that there is a thirty-four second interval during which none of the participants responds (even though Nish's posting is addressed to all the participants as a collectivity, i.e. "u guys"), and no other observable activity happens in the system, either in the chat or on the whiteboard, which is rather a noticeable silence for a chat in a small group like this.

Membership in a peer group—i.e., being a peer in the group—involves entitlements and obligations to act, such as asking a question, responding to a request or producing an account. Entitlements of a member are accorded unless otherwise called into question by specific actions. In this excerpt, Nish could have asked a question regarding his problem, but he chooses to make a report instead. If we take a closer look at the setting where the interaction takes place, we come to a better understanding of why Nish chooses not to ask a question. The session is set up for equal participation of all students. The expectation and entitlement of equal participation are also reinforced by the moderator's reiterated request for bringing Nish "up to speed" and the group's effort to summarize what they have done for Nish and to give him directions for viewing their previous discussion in response to the request. As a latecomer, it is natural for Nish to feel the need to participate. However the group is oriented to some current task, and asking a question irrelevant to it becomes a delicate matter since it takes the risk of interrupting the ongoing work. In other words, it is always possible to pose a question during a chat, but it must be appropriately situated. Nish's question about the group's previous work is not appropriate to the current interactional context. So Nish must engage in some interactional work to prepare a new context for his questioning.

In such an imbalanced power situation with its asymmetry of social obligations, structuring a report like Nish does is probably done out of consideration of being minimally intrusive yet still sending out the message, "I'd like to participate." It is also a request, negotiating how one can participate and be part of the group. Later in the chapter, we will analyze an excerpt taken from the second session of the same group, which serves as a contrasting case where a newcomer asks a question regarding a similar problem in understanding, as a way to demonstrate how the method chosen by a group member to make differences relevant to the interaction is very much locally situated.

One function of Nish's report is probably to initiate instructional work by eliciting questions from other participants to probe his problem in understanding. Such instructional work may be dis-preferred, thus avoided in a peer group in order to maintain peer relationships. Problems of participation may therefore arise, where repair becomes a relevant activity. One way to characterize the posting and the subsequent inactivity of the other participants from an interactional perspective is that there was an interruption in the progression of the interaction. One consequence of an interruption in progress is that something needs to be done to restore it if the interaction is to continue. Problems of progressivity call for repair work of some sort: Nish, whose posting led to the lengthy period of inactivity, would have to produce a next posting, or some other participant would need to do so. Given Nish's initial posting, what a next posting could be and who would produce it are a source

of interactional trouble for the participants. In this case, a next posting is produced by the Moderator who asks, “**can you tell us what’s puzzling you?**” (at 6:45:44).

This posting in a question form is quite clearly addressed to Nish, showing that the moderator has recognized there might be a problem of some sort that Nish has—possibly with understanding—which he is trying to indicate and presumably asking for help from the group. By using “**us**”, the moderator is acting on behalf of the group. The response that it is calling for is thus designed to be directed to the group as a collectivity. It positions the group as recipients and entitles them to respond to whatever Nish may articulate in the subsequent posting. In other words, the posting from the moderator does the work of recognizing the differences (either in math expertise or understanding) as made relevant by Nish’s report, and bringing the issue up to the group to deal with. It also puts Nish in the position of providing more specific information about his problem.

By responding to the moderator’s inquiry, Nish’s response at line 129, confirms with the moderator that there is some trouble in terms of his understanding of what the group has produced and in particular with “**the derivation of the number of squares.**” Though line 129 is not in an inquisitive form, combined with the moderator’s question that it is responding to, it constitutes a *question* in its own right, articulating Nish’s problem and at the same time indicating the need for assistance and calling upon the group to act: How did the group derive the number of squares? Posing a question of this kind instantiates the epistemic stance of Nish—that he does not know how the expression for the number of squares was mathematically derived—in relation to the group, positioning Nish as an actor seeking help from the group, and treating the group as entitled to offer the resource to address the epistemic differences. It is now up to the group to determine what an appropriate response should consist of and to work out among themselves who would actually produce or deliver the response.

## **How the Differences are Attended to: Response Construction**

In reviewing our data, we found that participants attend to differences in math as indicated in a question regarding math topics promptly without interactional trouble, in contrast to the lack of response to differences regarding an actor’s competency. Differences in competence may come from a variety of sources, for example, math skills, understanding or experience in the group, just to name a few. It is consequential for the interaction what kind of differences the participants highlight and how they treat them. Our analysis of the subsequent data excerpt in Log 8-2 shows that the difference made relevant in the interaction is treated by the group as an experience of being in the group while that part of work was getting done, instead of treating it as knowledge or as a conceptual deficit in math. In the postings from 130 to 134, Jason gives Nish a recap of what the group did by providing a *historical account of the group’s work*.

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130	06.46.21	Jason	oh
131	06.46.31	Jason	so you see in the list a column for "N"
132	06.46.50	Jason	when n=1, we have 1 square; for n=2, 3; and for n=3, 6
133	06.47.00	Jason	we came up with a formula to find the total number of squares for any number N
134	06.47.16	Jason	the purpose of the formula is so that you don't have to draw out the squares and count them
135	06.47.39	Nish	um yes
136	06.47.41	Nish	i know
137	06.47.51	Nish	but how did u get that formula

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How a difference is treated by the group as such is an interactional and procedural matter for the participants. When the difference is introduced by Nish as interactionally relevant to the group, the announcement at the beginning of the excerpt (line 126) is a report regarding his own math competence in relation to others in the group: “i am not overwhelmingly good at math as u guys seem to be.” Even though such a report is signaling the need for assistance, it may not be clear to participants (including the moderator) what the particular problem might be, as shown in the lack of response from the participants and the following intervention from the moderator.

How participants treat the differences probably accounts for the discrepancy between what the question may be asking and the response being provided as we take a closer look at the data.

In the five subsequent postings starting with line 130, Jason produces an account of the group’s work as a response to address Nish’s problem. These postings start with “oh” as a separate line, which is a marker of displaying his understanding of the request and also indicates there is more subsequent posting to come. He first directs Nish’s attention to “a column for ‘N’”, which is stated in the original problem description, and explained what the group has done: “we came up with a formula to find the total number of squares for any number N.” The use of the pronoun “we” and past tense (as in “came up”) suggest that this is produced as an historical account of what the group did earlier in the session, before Nish’s joining. However, there seems some disconnect between the group’s problem-solving steps provided in the two postings in line 132 and 133. The first one lists the number of squares for N from 1 to 3 whereas the following jumps to stating the result that the group found a formula for “the total number of squares for any number N.” This leaves out the mathematical reasoning on how the number of squares is generalized to N. These sequential postings from Jason end with a statement of the purpose of the formula: “so that you don’t have to draw out the squares and count them.” If we pay attention to the timestamp of those postings, we notice that they are being posted in a consecutive manner: there is only a few seconds before the next posting appears.

After the last posting from Jason at 6:47:16, the next posting appears 23 seconds later at line 135 from Nish: “um yes.” This noticeable time elapse marks the completion of Jason’s production of the response, delivered in five individual postings, and projects subsequent action of relevancy. The fact that there is no uptake

by other participants indicates that what Jason has produced may have been treated as being endorsed by the group as appropriate to address Nish's question.

## Reformulation of a Question

It is up to the questioner to assess the adequacy of a response to a question (Sacks, 1962/1995). The completion of Jason's production of the response calls on Nish to act upon it. In the following three postings by Nish, "um yes," followed by a separate line, "i know," together with a subsequent question, constitute a *dis-preferred* response. In a situation like this when a request for help is made and a subsequent explanation (which is rather elaborate in this case) provided, a preferred response would be acknowledging the usefulness of the explanation so that the interaction could progress without trouble. A dis-preferred response usually involves extra interactional efforts from the respondent such as providing explanation or an account. In face-to-face interaction, one could use a variety of ways to indicate a dis-preferred response, such as frowning, using disapproval or hesitant tone, etc. In chat, there has to be effort made to indicate such, which means a chat message has to be constructed to be read as dis-preferred, such as a posting being preceded by "um" in this case. The subsequent "i know" indicates that the response provided has not answered the question because what it explains was already clear to the questioner. This also shows that Nish understands much of what went on in the group, but he is specifically asking for help on a particular matter of mathematics—"the derivation of the number of squares."

A question from Nish, "but how did u get that formula" (line 137), with a preface "but" is posed immediately following the two short postings. The dis-preferred response consisting of the three consecutive postings constitutes an assessment of what Jason has provided in answering Nish's initial question. The question in line 137 can be seen as a reformulation of the initial one. It is constructed in the interaction among question-response-evaluation using the response and the initial question as resources. If recipients can and do reasonably infer that "i know" refers to the math content of the response, then the reformulated question is distinguishing (a) the mathematical derivation of the formula from (b) a recounting of its role in the past group process.

How does the discrepancy arise between the response provided and what the request for help may be asking for? Nish's initially posed "question" constructed through interaction with the moderator—"the derivation of the number of squares (is puzzling me)"—does not reveal to the group what he already knew. The question could be interpreted as asking about either (a) the particular mathematical manipulation of deriving the formula from a series of numbers or (b) the problem-solving steps that lead to the posted formula. The differences could be conceptual—as in lack of certain knowledge—or procedural—as caused by Nish's earlier absence from participation. In this episode of peer interaction, the fact that the group treats the differences as the latter seems to suggest there might be certain preferences in a peer group like this for treating differences as differences in group experiences rather than in personal competencies. Actors won't presume incompetence of any sort



unless there is strong enough evidence to make it relevant. In our case, the data in later excerpts show that the group finally assumes Nish’s incompetence as relevant and makes it explicit after the interactional troubles have accumulated to a certain point. At that point, the organization of participation in the group is consequently changed and the peer relationship is not maintained any more, as we will see.

## Doing Situated Expertise: Co-construction of the Response to a Question

In the analysis of Log 8-3, we show how situated expertise is effected by group members collaboratively—how the group organizes its interaction to attend to the differences and effects repairs when possible or finds ways to proceed when repair turns out to be ineffective.

*Log 8-3.*

138	06.48.00	Jason	oh	Ref to WB
139	06.48.11	Moderator	i believe so	Ref to WB
140	06.48.12	Jason	uh, basically you try to find a pattern in the total number of squares first	
141	06.48.47	Jason	we found a formula for that which we'll post on the wiki	
142	06.49.00	David	if you look at the patterns row by row, it's 1 + 2 + 3 + 4 + however many rows there are	

We see that Jason positions himself as the recipient (or one of the recipients) of the question, thereby acting as a local situated expert. He appears to be the first one who picks up Nish’s question and provides a response, which is presented in three individual postings. It starts with “oh” as a single posting (line 138), a marker signaling more to come in subsequent postings, which also serves as an indicator of expressing his increased understanding of the question, which his upcoming response is going to address.

This line 138 also has an explicit reference to the whiteboard, indicated in the log by “WB.” The reference appears as an arrow attached to the message in the chat environment (Figure 8-1), which is a feature of this environment that allows users to make explicit reference from a current message to previous chat message or to an area on the shared whiteboard. If we follow this reference of “oh,” we can see it is pointing to the “**Formula for total # of squares:  $n(1+n)/2$** ” in a text box created by the group on the shared whiteboard. The use of the graphical reference here serves to confirm Jason’s understanding of the deictic reference made in Nish’s question, **that formula**, therefore to establish their shared reference to the object, i.e., the specific formula as the common ground that the question-response interaction is based on. By making the deictic reference publicly visible to the group, it also creates an opportunity for other members’ assessment and invites participation from them to help construct a response together.

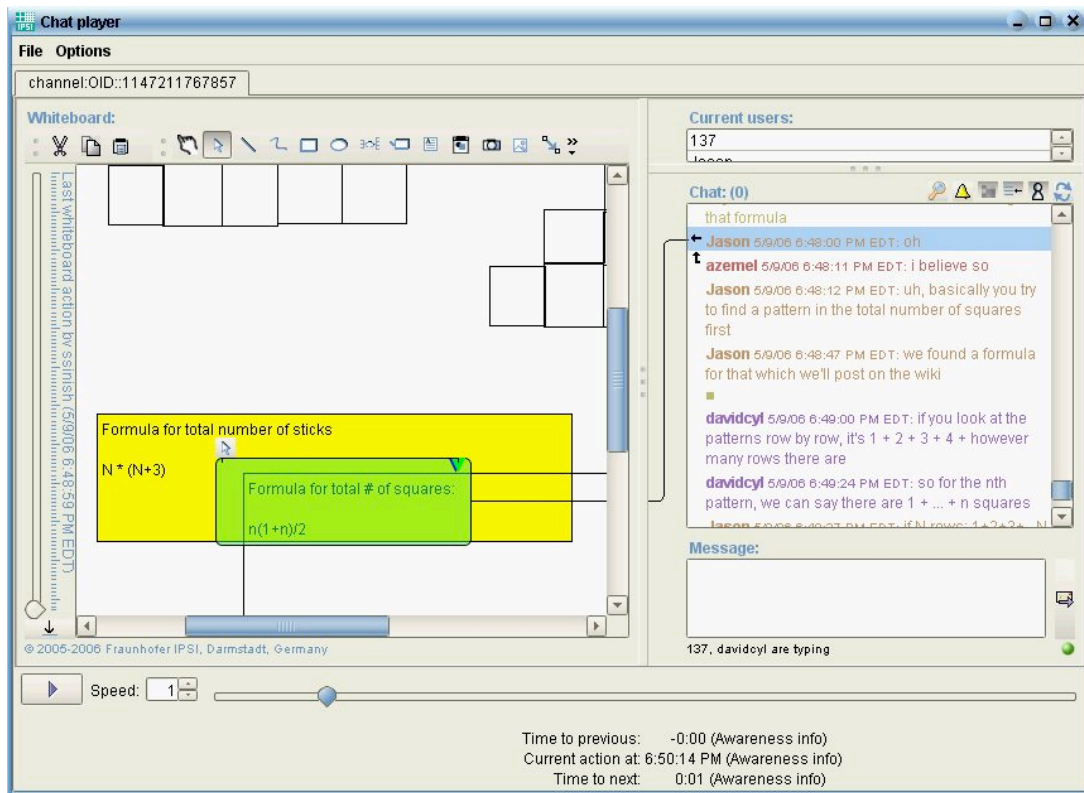


Figure 8-1. The session in the Replayer tool.

The use of “uh,” at the beginning of Jason’s next posting (line 140) also displays hesitation of some sort, possibly in the appropriateness of the upcoming content as a response to the question being posed. The response being provided here is presumably some kind of repair attempt that seeks to address the trouble that is made relevant by Nish’s dis-preferred reply. It is a reformulation of what Jason previously provided, which the reformulated question is projecting. However, Jason’s response is not particularly different from the earlier response he provided, which the current one is meant to repair: he is reporting the work the group did (**we found a formula**) and also what the group was oriented to (**for that which we’ll post on the wiki**), but not focusing on how the formula,  $n(n+1)/2$ , is mathematically derived. Such a report may be oriented toward giving the questioner an explanation from a higher-level problem-solving perspective by providing the steps the group has gone through. It is rather interesting that Jason insists on providing a response similar to the previous one just made, which has already been assessed by Nish in his dis-preferred response as not being appropriate since he already “knew” it. This suggests that actors are conservative of the trajectories they take in interaction, and it requires a considerable amount of work to get people to shift focus onto things other than what they have been working on in interaction. It is routinely the case that people must, over multiple turns at talk and interaction, work out their troubles. The trouble itself may only become evident in the process of working it out, which in our case is

demonstrated by the fact that other members jump in later to offer alternative ways to address the trouble. It also seems to suggest a preference members in a peer group may have in what constitutes an appropriate response to address a newcomer's question in order to “catch up”—which is reviewing group experience over providing conceptual math knowledge, as exhibited earlier when the differences are attended to. This may help explain why Nish originally stressed his need for help with math because he wanted an explanation of the derivation of the formula, not the problem-solving steps the group went through that Jason insists on providing.

There is a pause of 35 seconds between Jason's two separate postings at line 140 and 141, which is an interactionally significant duration in a chat like this. A further, closer look at what happens during this period as we step through the unfolding interaction using the VMT Replayer tool reveals that there is a 12 second interval between when the posting at line 140 appears and the next awareness information “Jason is typing” shows, immediately followed by another awareness information “David is typing” just 2 seconds later. The finished messages anticipated by the awareness information are posted later in line 141 and line 142. Although Jason's posting in line 140 is explaining what the “first” step should be, therefore projecting subsequent postings by him on following steps, the 12 second interval during which no observable activity takes place nevertheless indicates the possibility of some interactional trouble and opens up the space for any participants including Nish, the questioner, to address that trouble. It allows the questioner to assess the response or other group members to construct an appropriate response to the question together. David offers a way of addressing the question as an alternative to Jason's response, implying that there may be another relevant kind of response, different from the one Jason has produced.

David starts Log 8-4 by describing how the pattern of the number of squares grows “row by row” in relation to the number of rows. He then continues to present how the pattern is being generalized to the Nth, which is very similar to what Jason posts in the following line (144) that appears only 3 seconds later. Jason's posting “if N rows: 1+2+3+...N” does not stand alone as a meaningful and coherent statement if not read together with David's posting at line 142. It fits seamlessly into the sequential unfolding of the posting just as David's subsequent one does. When we replay the session in real time, the awareness information in the system shows that Jason started composing his message after David's first one was posted and while David's second posting was still being composed. Analysis of the sequential relation of messages suggests that line 144 posted by Jason is built on David's first posting.

*Log 8-4.*

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143	06.49.24	David	so for the nth pattern, we can say there are 1 + ... + n squares	
144	06.49.27	Jason	if N rows: 1+2+3+...N	
145	06.49.57	Jason	so then we incorporated the formula for finding the sum of an arithmetic series	
146	06.50.12	David	there's a formula for finding the sum of consecutive integers, which (when starting from 1) is: $n(n+1)/2$	
147	06.50.17	137	so you use gaussian sum to get $n(n+1)/2$	Ref to123
148	06.50.25	Jason	that's it	Ref to146

This excerpt displays an instance of how a group engages in doing situated expertise collaboratively by taking up and building on each other's postings and endorsing other's contributions. Jason and David respectively present that there is an existing formula (“for finding the sum of an arithmetic series” or “for finding the sum of consecutive integers”) ready to use, which they “incorporated”, as stated by Jason in line 145. David also explicitly provides the formula:  $n(n+1)/2$ . This contribution is similarly made by the other participant, 137, in the next line that comes just 5 seconds later, where he refers to the formula as the “gaussian sum” and also presents the formula explicitly.

David's statement about the formula in line 146 is endorsed by Jason: “that's it,” with reference pointed to it using the reference tool (line 148). In his subsequent posting, David also explicitly endorses Jason in line 149 using explicit reference “as Jason said” and direct quote with slightly changed wording, i.e. arithmetic sequences in general vs. an arithmetic series. From line 142 to 149 within the period of one and a half minutes or so, the postings from three different participants—namely Jason, David, and 137—align with and build on each other. Together, they construct a rather coherent and complete explanation, at least from the three question recipients' perspective, in response to Nish's question.

## How Making the Relationship Explicit Changes Participation

In our case, the group completes the construction of a response to the posed question. The completion is marked by David's endorsement of Jason's explanation regarding the formula and the noticeable 16 seconds elapse that follows where no more posting from the three participants is made. The completion of the question-response pair puts Nish, the questioner, into the position of reacting to the response provided, e.g. making an assessment of it. Nish's response does not come out until 16 seconds later in a very brief form, displaying great hesitance and uncertainty: “hmm...” Again, Nish presents a dis-preferred response to the proffered explanation. The hesitation marker posted at line 150 of Log 8-5 prepares recipients for the initial indication of uptake at line 151, “isee,” and the possible production of a contrastive beginning with “but ...” (as we saw earlier, at line 137). Nish does not produce a contrastive posting. From the Replayer tool, we notice that Jason starts composing his message about the same time as Nish starts composing his reply, which he posts at the same time as Nish's second short acknowledgement “isee.”

*Log 8-5.*

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150	06.50.51	Nish	hmm...
151	06.50.56	Nish	isee
152	06.50.56	Jason	on a side note, you'll be doing stuff of similar sort next year in
Algebra II			
153	06.51.01	Nish	thanks

It may be the case that Jason's post at line 152, "**on a side note, you'll be doing stuff of similar sort next year in Algebra II,**" was produced and posted in such a way as to circumvent further specification of Nish's query. Another feature of this post at line 152 is that it (a) problematizes Nish's math skill level and competence (as indicated by the remark that Nish will not be exposed to the kind of problem they are working on until the following academic year) and (b) makes the matter of Nish's competence available as a matter of public concern to all parties to the interaction. Nish thanks the group promptly without further comments. David then orients the group to the business that they were working on prior to this whole question-response sequence by proposing the task "**ok so let's finish the problem.**" Nish does not challenge this bid to move on and stops asking further questions regarding the same topic.

The most notable feature of this last portion of the sequence is that there is a shift in topicalization from the mathematics to the skill level of the participant. This constitutes a change in the organization of participation among members that, as subsequent interaction displays, changes the nature and distribution of entitlements, obligations, expectations, etc., among participants. One question left for us to wonder is how such noticeable change of the organization of participation happens. Here we offer explanations from a perspective combining conversation-analytic and peer-group-interactional approaches.

In their response to Nish's question, the three participants treat the formula  $n(n+1)/2$  as something already existing that has been "**incorporated**" (in Jason's words) into the construction of their problem solution. By offering this as established knowledge, they assume this knowledge is available and accessible to all, including the questioner. That there were questions about the formula does not mean necessarily that the questioner is incompetent, at least initially. It is only when others have attempted to respond and these responses (a) are deemed by respondents to be adequate ways of addressing expectable troubles with respect to the formula, but (b) do not resolve the questioner's troubles, that an alternative source of the trouble may be investigated or proposed to account for the apparent failure of the responses to resolve the problem. In this case, Jason presents the fact that Nish has not studied this material and cannot be reasonably expected to competently understand it.

Up till now, the differences made relevant by Nish's first statement and subsequent question have been attended to by the group as differences in situated, local expertise. The participation and interaction have been organized around addressing the differences at hand as topical, i.e., mathematical matters rather than issues of personal competency. Jason's posting in line 152 however made the issue of relationship itself—i.e., a person's competence or incompetence—a matter of concern. By saying that Nish will "**be doing stuff of similar sort next year in Algebra II,**" Jason comments on Nish's studied math preparation, which interactionally serves as a mechanism to shut down this line of discussion. The peer relationship is not maintained anymore, which means certain entitlements of being a peer no longer exist, such as asking a further question regarding the same topic. Such a break down does not however necessarily mean that the peer relationship is never to be restored.

In fact, there are ways a member like Nish in this situation may try to establish the peer relationship again.

In the rest of the session, Nish remains silent for most of the time except at one point (about 6 minutes after his last posting in line 153), when he poses a very carefully phrased question about what a summation is (Log 8-6, line 175). This probably is an attempt made by Nish to get engaged in the ongoing discussion of the group as a way of trying to maintain the possibility of participation and to re-establish the peer relationship. We also see that the question is posed in an artful way of “bracketing” the relationship issue by making the competency issue explicit by the questioner himself. By starting the question with a self-conscious statement “**hope this doesnt sound too stupid,**” the questioner is thus minimizing the chance of a similar judgment being made by the recipients of the question, i.e., the peers in the group.

*Log 8-6.*

175	06.56.58	Nish	hope this doesnt sound too stupid, but wuts a summation (two lines that are not relevant to this thread of discussion are omitted here)	
177	06.57.34	137	The sum of all terms from a to b	Ref to 175
178	06.57.36	Jason	<a href="http://en.wikipedia.org/wiki/Sigma_notation">http://en.wikipedia.org/wiki/Sigma_notation</a>	
180	06.58.11	Jason	don't worry Nish, you'll learn all about it next year	

This question is responded to by participant 137 with a direct answer, “**The sum of all terms from a to b**” and also by Jason with a URL pointing to a Wikipedia article, which presumably contains the information to answer Nish’s question. Following his response to Nish, Jason also makes a comment similar to the one he made earlier that addresses the personal competency issue (but not the topic of the question itself): “**don’t worry Nish, you’ll learn all about it next year.**” The way the question is taken up by Jason—by providing a pointer to the resource rather than an answer to the question—shows the change of the participation within the group, besides what has been made evident by Nish’s lack of participation and his discreetly constructed question. Making the issue of incompetence explicit again shuts down Nish’s chance of getting involved in the group discussion and re-establishing the peer relationship. As a matter of fact, Nish remained silent through the rest of the session until near the end. After the three other participants left the chat, which is approximately fourteen and a half minutes after Nish’s question on the summation, Nish posts the following: “**sorry bout holdin u guys up**” (at 07:12:24). When the moderator thanks him, Nish seems puzzled and is not sure whether that is a compliment (Log 8-7).

*Log 8-7.*

273	Moderator	thanks for slowing them down and getting them to explain	07.13.16
274	ssjnish	?	07.13.27
275	ssjnish	was thqat supposed to be a compliment...?	07.13.46

Nish’s self disclosure of his feeling again confirms that the way the relationship issue was made explicit as a matter of interactional concern proved consequential for the subsequent organization of participation in the group.

## A Contrasting Case

Now we will provide a contrasting case in order to reveal how participants choose methods for making differences in understanding and expertise interactionally relevant. This illustrates how a question can be constructed to indicate the need for assistance while at the same time demonstrating the questioner's competence of being a member. In this episode of interaction, a newcomer to the group poses a question regarding the same formula in the data we have previously seen, and a response is provided that turns out to address the question properly without any observable interactional trouble.

Log 8-8 starts near the beginning of the second session by the same group. Jason and 137 have joined the session, waiting for others including Nish and David to come. A newcomer Qwer who was not in the first session has just joined. In response to the moderator's request to "**bring Qwer up to speed**," Jason briefly describes what the group did in the last session and orients the newcomer to the resources in the environment including the formula, the discussion and the online wiki.

*Log 8-8.*

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333	Jason	ok, so with this aside-- i guess we should discuss our feedback from the last session	07.18.07	
334	Moderator	make sure you bring Qwer up to speed	07.18.34	Ref. to 333
335	Jason	ok	07.18.41	
336	Jason	for the problems last session, we came up with formulas to find the values for the columns	07.19.35	Ref. to 332
337	Qwer	in the view topic thing?	07.20.02	
338	Jason	You can see them to the left of this text; our formula for the total number of sticks or squares for any number N is given	07.20.03	
339	Jason	yes	07.20.09	Ref. to 337
340	Qwer	ok	07.20.12	
341	Jason	that was the problem we were given	07.20.17	
342	Jason	remains of our discussion is on the whiteboard and online wiki	07.20.39	

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About three minutes later, Qwer poses a question regarding the formula "**how did you get  $n(1+n)/2$** ." That comes after some account of mathematical reasoning steps, which are composed together within the same posting (line 345, Log 8-9). A response is then produced and provided by Jason. It starts with Jason's signature marker "**oh**" just seven seconds later in a separate posting as an opener to his upcoming explanation that consists of two parts: a sentence on what the formula is (i.e., **for finding a series of consecutive numbers**) and a mathematical equation that demonstrates this notion. Participants, including both the questioner and the respondent, then move on to other topics about some newly introduced features of the chat environment, which is not included in the log here. No further problems or issues are raised and the response is treated as appropriate in addressing the posed question. This marks the completion of the question-response interaction, which only takes about half a minute.

345	Qwer	n=3 is 3+2+1 squares, n=4 is 4+3+2+1 squares... how did you get $n(1+n)/2$	07.23.35
346	Jason	oh	07.23.42
347	Jason	that's the formula for finding a series of consecutive numbers	07.23.53
348	Jason	$1+2+3+4+\dots+n = ((n)(n+1))/2$	07.24.08

By reviewing the data of the two episodes of question-response interaction—involving Nish and involving Qwer—we notice some significant differences in the organization of participation in the group interaction. First of all, the two questioners used different methods to introduce *differences* to the group interaction: one makes a report regarding his own competency in math while the other asks a question regarding the math topic in a straightforward way. In the second episode of interaction, Qwer is a newcomer to the group who joins right at the beginning of the session. The group is still coordinating to get ready for working on a particular task of doing math. The expectation of participating, presumably already understood by the participants—also stressed by the moderator’s request to “bring Qwer up to speed”—makes it legitimate for the newcomer to ask a question, particularly about problems of understanding the group’s work in the previous session. There is little danger of interrupting or deviating the group from its workflow, as compared to the first case we analyzed. Qwer also has more time to focus on catching up to the group’s work without worrying about keeping up with the current discussion on math, like Nish had to do. This perhaps helps with his understanding of the work, thus increasing his ability to construct an appropriate question.

Secondly, as shown in the data, each method results in a particular way that the subsequent participation is organized. In the first case, the self-assessment report introduces significant interactional trouble. A question only gets produced with the intervention from the moderator. It takes several turns and tremendous work for the group to finally work out the troubles among themselves and complete the question-response. At the end, the issue about the questioner’s competency is raised and made explicit, which causes the questioner to be excluded from the group as a peer. In the contrasting case, there is no observable interactional trouble. An appropriate response is provided to the question, and the questioner is treated as a full-fledged member of the group in the subsequent interaction in the session.

Finally, the way the question is produced is quite different in the two cases. Nish’s initial question “**the derivation of the number of squares** (is puzzling me)” lacks any indication of what he already knew. In contrast, Qwer shares with the group what he already understood through a description of the math reasoning in the problem-solving steps before posing the question. What the question could possibly be asking is made quite clear by ruling out other possible readings of it. By doing this, Qwer also demonstrates his competency at understanding the mathematical work and being a member of this peer group. The entitlements of being a peer are enacted in and as the ongoing participation. For instance, in the early interaction Qwer has with Jason, he is being responsive to Jason’s effort of orienting him to the available resources in



the environment, and he shows his engagement in the process. All of these allow the peer relationship to be preserved.

## **The Interactional Emergence of a Question**

As revealed in the analyzed logs, in an online collaborative context like VMT chats, questions are not simple, well-defined queries for information, but situated moves within the group process. For instance, Nish's question about the formula goes through several steps to emerge. As a latecomer, he does not pose the question in the middle of the group's discussion of the problem. Instead, he makes a report regarding his own math ability in comparison to others in the group, which builds the context of asking a question. We have seen that the moderator solicits a question from Nish in response to the report. Nish's answer to the solicitation serves as a question to the group. The *question* is thus co-constructed through the interaction among the group, including the noticeable silence after Nish's initial report and the intervention from the moderator as a consequence. The meaning of the question is interpreted interactionally: Jason offers the history of what the group did as a perceived appropriate answer. The answer gets rejected by Nish, who subsequently reformulates the question. Reformulation of the question draws on the answer offered as well as the initial question as resources, which help eliminate other possible interpretations of its meaning. The group engages in a collaborative effort of building a response to the question. Their response is offered and considered by them as appropriate in addressing the question. However, the questioner, Nish, provides a dis-preferred reaction, treating the offered response as inadequate. The group respondents react by introducing another source of trouble, the incompetence of the questioner, and make this relevant to the group interaction. The consequence of this is that Nish is effectively shut out and the peer relationship is dissolved. In summary, a question emerges through the interactions of the group and goes through several steps; in each step, the meaning of the question is re-interpreted interactionally and its consequences are played out.

Math proposal adjacency pairs as a particular kind of adjacency pairs of interaction have been studied within the VMT Project. In particular, analysis of a "failed proposal"—in the form of a question—suggested some characteristics of successful proposals (Stahl, 2006, pp. 445-451). Drawing on this, we have contrasted a "breakdown" example of a question-response interaction to a successful case in an attempt to pull out what a "successful question" may consist of. The analysis suggests the following characteristics for successful questions, some of which bear resemblance to those for successful proposals:

- (a) *A clear question structure that elicits a response.* Making a report of one's math competency may indicate some problem of understanding, but not present a question of its own. It does not elicit a response from the group. A question on a math topic with a clear structure is more likely to elicit a response without interactional trouble.

- (b) *Information on what is known by the questioner.* A question such as “*the derivation of the number of squares*” may be ambiguous as to what it is really asking for as there are multiple possible readings of it, such as the derivation by the group through a sequence of inquiry moves or the derivation of the pattern as a mathematical proof. Providing information on what the questioner already knew can help rule out some possibly readings of the question, such as “**n=3 is 3+2+1 squares, n=4 is 4+3+2+1 squares... how did you get  $n(1+n)/2$** ”. This may be particularly important for successful question-response interaction in a small peer group, in that such information also demonstrates the questioner’s competence at being a member of the peer group.
- (c) *Right timing and interactional context within the sequence of interaction.* Posing a question irrelevant to the ongoing discussion takes the risk of interrupting the group and deviating from the topic; careful work is needed to build the context for the question, and this risks failure.
- (d) *Engagement in the group process.* Indication of being engaged in the group process is also helpful in that it contributes to enacting and maintaining the peer relationship. For instance, being attentive to the group’s effort on catching him up demonstrates Qwer’s understanding of the work the group did. It helps rule out alternative meanings of the subsequently posted question. Failing to engage in the group process like Nish does during the response construction is destructive to the peer relationship. Once the peer relationship is not maintained, the group stops the effort of addressing the question and the entitlement of asking further question on the same topic disappears.

Question-response interactions are key to pursuing group problem-solving strategies (Zhou, Zemel & Stahl, 2008), building a joint problem space and sustaining the team discourse. Questions are ostensibly posed by participants for information seeking or help seeking by individuals. As revealed in the analyzed logs, the question-response pairs also function at the small-group level as mechanisms for managing peer relationships and organizing participation. In our case study, they can function to include—or exclude—a member. They can play an integral role in the social relations among the participants, positioning individuals as more or less competent and maintaining or adjusting peer standings.

## References

- Barron, B. (2003). When smart groups fail. *The Journal of the Learning Sciences*, 12(3), 307-359.
- Cohen, E. G., Lotan, R. A., Abram, P. L., Scarloss, B. A., & Schultz, S. E. (2002). Can groups learn? *Teachers College Record*, 104(6), 1045-1068.
- Garfinkel, H., & Sacks, H. (1970). On formal structures of practical actions. In J. Mckinney & E. Tiryakian (Eds.), *Theoretical sociology: Perspectives and developments* (pp. 337-366). New York, NY: Appleton-Century-Crofts.
- Sacks, H. (1962/1995). *Lectures on conversation*. Oxford, UK: Blackwell.
- Schwartz, D. (1995). The emergence of abstract representations in dyad problem solving. *Journal of the Learning Sciences*, 4(3), 321-354.

- Stahl, G. (2006). *Group cognition: Computer support for building collaborative knowledge*. Cambridge, MA: MIT Press. Retrieved from <http://GerryStahl.net/mit/>.
- Zhou, N., Zemel, A., & Stahl, G. (2008). *Questioning and responding in online small groups engaged in collaborative math problem solving*. Paper presented at the International Conference of the Learning Sciences (ICLS 2008), Utrecht, Netherlands. Retrieved from <http://GerryStahl.net/pub/icls2008nan.pdf>.