

# Social Barriers to Meaningful Engagement in Biology Field Trip Group Work

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**ABSTRACT:** This paper reports on a study that employed metacognition and social cognition theoretical frameworks to explore and interpret students' views of their cognitive roles and the nature of the mechanisms that they considered influenced and mediated their learning within small group contexts. An instrumental interpretive case study methodology was used to capture students' descriptive accounts of their Year 11 Biology learning experiences, as conveyed through their recollections and reflections concerning their interactions and roles, perceptions of the learning task, and their learning strategies that they considered to be manifest during a field trip visit to a nature center. We conclude that, even among apparently highly collegial student groups, deemed by their teacher to be effective learning groups, and constituted in ways consistent with the literature on effective collaborative group work, there existed metasocial metacognitive factors that influenced and shaped cognition in ways counterproductive to the effective learning of science. This study reveals the

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existence of metacognitive knowledge and processes, common among students and related to their views of what is appropriate thinking and behavior within small groups, which inform collective and individual task actions. We contend that students are highly aware of their social status within groups and of their individual group's social conditions and that this awareness affects cognition and behavior. Moreover, they monitor these conditions and employ strategies that simultaneously service both the task and social relationships and their learning processes to varying extents depending on individual and group factors.

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### INTRODUCTION

Visits to natural ecological settings provide enjoyable, rich, authentic (Pedretti, 1997) and salient real-life experiences that can enhance biology learning. Rickinson et al. (2004) propose that if such activities are “properly conceived, adequately planned, well taught and effectively followed up” they can offer “learners opportunities to develop their knowledge and skills in ways that add value to their everyday experiences in the classroom” (p. 1). Furthermore, the use of collaborative group work as a pedagogical practice for promoting learning in field settings, as in classroom settings, is well justified and supported (cf., Burnett, 1995; Gokhale, 1995; Johnson & Johnson, 1986). Such perspectives are most often “taken as given” in science education circles.

Much fieldwork in biology education is structured around group activities, and this practice is long-standing. Students working in groups have opportunities to collaborate to complete tasks and activities, and it can be reasonably expected that the nature of their collaboration with each other would reflect the social norms of their community of practice (Roth, 1998) in relation to science and biology learning, which, in turn, are embedded in the social milieu of their broader culture that determines which practices are considered socially appropriate or otherwise. In groups where deep learning is the primary goal, we would expect extensive discussion of data, ideas, and propositions so that shared understanding could be developed (Hogan, 1999). Such a perspective is congruent with, for example, the writings of Driver, Asoko, Leach, Mortimer, and Scott (1994), Duschl (1990), Newton, Driver, and Osborne (1999), and Jimenez-Aleixandre, Rodriguez, and Duschl (2000) who contend that processes such as argumentation are key forms of scientific reasoning and that training teachers and students to actively engage in such processes holds promise and direction for improving science education. On field trips, it is reasonable to expect that processes such as argumentation might and should be encouraged to be practiced within groups as students discuss answers to questions posed and seek to develop explanations for their data. This has not always been found to be the case in classroom studies.

The majority of studies that look at students' reasoning in groups in science education have focused on the transactions between members and learning outcomes emanating from group processes (e.g., Falk, 1997; Hogan, 1999; Taylor & Collier, 1999). Given the science education community's interest in the development of conceptual understanding, this focus is not surprising. Suggestions for improving group functioning and learning from such studies have included how to best constitute groups (Johnson, Johnson, & Holubec, 1998), instrumental agents of both socialization and control, and motivational tools within a continuous cycle of learning (Baskin, 2001). However, Tindale, Meisenhelder, Dykema-Emgblade, and Hogg (2004) suggest that research regarding group transactions has begun to focus “not only on the degree of sharing but also whether members know what is shared and not shared among the group members” (p. 283). Furthermore, Tindale et al. propose that shared metacognition “can be viewed as members' knowledge of what other [group] members know” (p. 283). Moreover, they assert that

... other group members can serve as memory aids. . . In this way, the group can remember much more than any given member, yet each member has access to the entire information in the group by knowing which members know what. It is the shared metacognitive knowledge that allows each member access to the group's entire store of information. (p. 283)

The reference of Tindale et al. to metacognition relates to the purpose of this research, which differs from the aforementioned foci. Metacognition has commonly been viewed as an individual's knowledge, control, and awareness of his/her thinking and learning processes (Baird & White, 1996; Gunstone, 1994; Kuhn, Amsel, & O'Loughlin, 1988). However, recent work has consolidated a broadened perspective of metacognition based on Flavell's (1976, 1979) previous work that includes reference to students' knowledge and awareness of others' thinking and learning processes (Anderson & Nashon, 2007; Thomas, 1999; Thomas & McRobbie, 2001). This expanded perspective is consistent with sociocultural views of cognition that draw attention to the notion that students can and do learn to reason by reflecting on the processes by which others within their communities reason and by modifying accordingly their own thinking in ways they feel will benefit them. An individual's knowledge and awareness of what his/her fellow group members know and don't know, how they reason and when and why they reason as they do, and their flexibility or otherwise regarding their views and beliefs, can be useful for individual and group knowledge construction and for knowing who can be turned to for aid in successfully completing group learning tasks. Previous work by Bianchini (1997) has confirmed such a view by drawing attention to how students' perceptions of each others' intellectual status influences rates of on-task talk and the extent of learning of group members. Bianchini argued for a "greater recognition of group work's complexities" (p. 1040), and it is this complexity in relation to social factors that we seek to further recognize in this paper.

Claxton (1993) has conjectured that social factors and priorities might be more powerful influences on group discourse, action, and decision making than the often stated aim of achieving meaningful academic learning. For example, if a group member suspects that a potential negative impact on group harmony or functioning might result from attempts to correct a fellow member's ideas, Claxton speculated that the person might act to maintain group harmony by not appearing offensive or dogmatic, irrespective of the unviability of their fellow group member's ideas. Factors such as these that influence individuals' action and thinking and that have the capacity to influence the potential for individual and collective meaningful learning in group settings are what we consider in this paper to be metasocial elements of students' metacognition, specifically of their metacognitive knowledge.

This view is consistent with recent revisions of the taxonomy of metacognition that seek to categorize qualitatively distinct types of metacognitive knowledge according to the cognition each type is aligned with. A recent example of this categorization is provided by Yürük (2005, 2007), who refers to metaconceptual metacognitive knowledge as that knowledge that relates directly to control, monitoring, and evaluation of the cognitive processes individuals employ to develop conceptual understanding, i.e., one's knowledge about concept learning and factors affecting concept formation. We define metasocial metacognitive knowledge as those elements of an individual's metacognitive knowledge related to social interactions and relationships and how these affect cognition, learning processes, and task behaviors. As with other forms of metacognitive knowledge, we propose that such metacognitive knowledge is constructed by individuals over time and relates to and is influenced by their metacognitive experiences and the cultural contexts within which they learn to reason.

In this study, rather than focus on the science learning taking place or analyzing closely the intragroup transactions and discourse, we seek primarily to elucidate how students' metacognition, and in particular its metasocial knowledge component influences group

processes and interactions. Such a focus is not conspicuous in the science education literature. However, as previously suggested, such issues have not been the focus of past research in science education due to many researchers' interest in knowledge construction, group discourse, and other forms of intragroup transactions. The purpose of this paper is to examine what we consider to be underrecognized and underappreciated conscious and unconscious metasocial elements of metacognition that influence students' engagement in meaningful learning and their deployment of higher order cognitive processes as they engaged in group work in a high school field trip.

### CONTEXT OF THE STUDY

A class of Year 11 Biology students (15–16 years old) participated in a field trip experience to a protected ecological reserve (the nature center) comprising wilderness forest setting in the lower mainland of British Columbia, Canada. Several layers of informed consent were sought and received prior to the implementation of the study, including university ethics clearance, school board approval, principal and teacher consent, and signed consent from individual students and their parents/guardians. The field experience in this study was designed and developed by the classroom teacher in collaboration with the research team that included two experienced biology teachers. The field trip task was what might be considered traditional in biology education as it centered on students working together in groups to collectively examine a large transect of wilderness environment that straddled three distinct zones: (a) a heavily wooded forest environment with high, thick tree canopy and mossy ground cover, (b) a moderately forested area with small trees and dense scrub ground cover, and (c) a moderately thick grassland zone. Students were required to work in groups comprising three or four individuals to identify and describe different organisms, the biotic and abiotic factors in the zones, and the influence of these factors on the organisms that might account for their distinctiveness in that environmental context. Students were given written and verbal instructions before the excursion regarding what data should be collected, what observations should be recorded, and what questions should be answered on a worksheet that was prepared by the research team and classroom teacher.

### DESIGN AND THEORETICAL POSITION OF THE STUDY

This study focused on understanding the nature of metasocial metacognitive knowledge influencing the cognition and learning processes of students as they engaged in-group activity on their field trip. Initially, the research had focused strictly on issues of student metacognition in terms of exploring the knowledge, control, and awareness of aspects of students' individual learning processes. However, a consequence of the interpretive, hermeneutic nature of the research design was the revelation of additional issues, namely, group and individual knowledge and self-awareness of roles, the social status of individuals, and the cognitive processes of others, that were not originally foreseen as part of the initial guiding metacognitive framework. This paper reports on these metasocial elements of metacognition that are very rarely, if at all, considered when interpreting learning, group interaction and behavior in science field trip settings or, for that matter, across science-learning settings.

The study utilized two theoretical frames to interpret the nature of the mechanisms that were governing learning processes and related interactions in the small groups. Specifically, a metacognitive frame (Baird, 1986; Baird & White, 1996; Flavell, 1987; Gunstone, 1994; Larkin, 2006) and a social cognition frame (Billett, 1996; Brewer & Brown, 1998; Hogg & Abrams, 1988) were employed in describing and interpreting the students' cognitive

roles as they worked and reflected upon the group-learning tasks undertaken during the field trip. The metacognitive frame is often employed to understand the higher executive processes overseeing and controlling cognition. However, most of the literature in this field, particularly within science education, has considered the individual as the sole unit of analysis, and not considered the group. Thus, the additional lens of social cognitive theory, which according to Brewer and Hewstone (2004), “extends beyond the understanding of individual behavior to the level of interpersonal relationships, group processes, and intergroup behavior” (p. xi), was utilized. Social cognitive theory was deemed useful to understand the individual within the social group and the factors shaping students’ learning processes.

The study employed an instrumental, interpretive case study methodology (Gallagher & Tobin, 1991; Merriam, 1998; Stake, 1995) to capture and construct accounts of students’ experiences, their self-reflections of their interactions and roles, their self-perceptions of the learning tasks, and their learning strategies that were manifest for them. Also, we asked students to explain and elaborate on any other strategies that they considered promoted their group and individual functioning, their learning and their task completion. Interpretive strategies are appropriate for this study since credible accounts of group interactions and the nature of the students’ thinking as they interacted with each other were to understand elements of their metacognition governing and shaping their cognition and learning processes.

The data corpus collected at the nature center included researcher field notes, video recordings of the three groups’ interactions, and individual voice recordings of each of the 10 case students’ (three groups) conversations. These voice recordings were captured by means of personal digital audio recorders and lapel microphones that students wore during their engagement in the field tasks. Following the completion of the tasks, audio recordings of students’ personal verbal discussions were burnt onto CDs. These CDs were then given to each of the students, and they were asked to listen to their conversations and discussions before being interviewed in their small group cohorts 2 to 3 days later regarding their experiences, reflections, and what they had learned. This experience of listening to their own individual discourse enabled students to self-reflect on their own roles and interactions within the group and upon their own learning and learning strategies (Anderson, Nashon, & Thomas, in press).

All three case groups were interviewed as individual groups two times for about 1 hour each time over the course of the research. The interviews were conducted in a conversational manner. As part of a reconceptualized stimulated recall process that acknowledges the interview itself as a potential metacognitive experience for the participants as well as an investigative process (Anderson et al., in press), the students viewed video clips of what the research team considered to be critical incidents of their group interactions in the nature center. These incidents were selected on the basis that they were considered indicative episodes in which individuals or their group as a whole engaged in discussion relevant to the development of their knowledge and understanding that was related to task completion. The video clips were instrumental in assisting the group members to self-reflect on their roles, their group interactions, learning, and learning processes (Anderson et al., in press). Students were also given opportunities and encouraged to discuss their self-reflections arising in response to their listening to their personal conversations, discussions, and deliberations recorded at the nature center. As this was part of a larger study of students’ metacognition and learning across learning environments, the interviews canvassed a wide range of areas related to the groups and their members. These topics included their views, attitudes and past experiences regarding fieldwork, their metacognition related to learning across classroom and informal contexts, and their reflections on the science learning that

they achieved as a consequence of their fieldwork experience. The exploration of the metasocial metacognitive factors emerged out of the hermeneutic process and was not the sole or privileged target of the interviews. However, we acknowledge that students may make decisions about what might constitute the most appropriate answer in any interview situation according to the nature of the questions asked, the context of the interview, and what they might consider the researchers might like to hear. Therefore, the claims made in this paper should be considered with reference to such potentialities.

Prominent in the data analysis was the research team reviewing and interpreting collectively the video and audio data of the groups' interactions and conversations in the nature center and their postvisit interviews. These reviews involved an iterative process of case analysis and critical reflection by the research team who scrutinized each case group's activity, discussions, and reflections. This process led to rich understandings of individual's and their respective group's characteristics of their experiences and thinking during the field trip. These understandings were constructed from independent researcher interpretations that were then negotiated, amended, and endorsed during team meetings. During these negotiations, the team determined the common parameters that would be explored across the case groups. For example, leadership was seen as a common characteristic across individuals and groups that was noteworthy for providing context for understanding the nature and influence of students' metasocial metacognitive knowledge. Leadership and the other characteristics shown in Tables 1–3 were deemed to be stratified into three levels; low, moderate, and high; where low represented little if any evidence of an individual's behavioral traits that directed group activity or discourse and high represented substantial evidence of such traits. Further explanation of the tables is provided below.

Our prime intention is to report our findings in relation to students' explanations as to why they chose or otherwise engaged in the forms of discussions and related reasoning that they did as they participated in their field trip experiences. Therefore, we report our overall perspective of the nature of the groups' discussion and thinking and individual's engagement in their thought processes rather than report detailed analyses of their behaviors and interactions. In focusing our report in this way, we seek to more fully understand and articulate students' reasons for their engagement as proposed by themselves rather than relying on our own conjectures. In doing so, we also attend to students' views of the social aspects of their experiences in relation to their learning context and their self-reflections, and seek to affirm and respect their voices in relation to who they are and what they know as suggested by Lensmire (1998).

## THE PARTICIPANT BIOLOGY STUDENTS AND SCHOOL CONTEXT

One class of Year 11 Biology (26 students) and their teacher volunteered to participate in the study. The public high school that the students attended drew predominantly from a moderately privileged socioeconomic demographic, and was considered to be a very typical metropolitan high school. The school curriculum (including the biology curriculum) adhered to provincially mandated content and standards. In the Province of British Columbia, senior high school students are all required to sit for standardized provincial examinations in the curriculum areas they study. Hence, examination-based assessment and activities that are perceived to enhance performance on the provincial examination were highly valued by students. Students' descriptions of their biology classes suggested that they were taught in a traditional transmission-based manner characterized by teacher-directed lessons, very frequent use of textbook as the main information source of lessons, rote learning of biological facts (e.g., species, phylum, nomenclature), a lack of field experiences to support learning, very infrequent use of group learning approaches to facilitate learning, and few learning

experiences that were aimed at producing higher order reasoning or that challenged students to engage higher order thinking strategies. The following discussion from one group of students provides an exemplar of the students' views of the classroom context. All names are pseudonyms.

- Patricia: It's uncommon for us to do group activities in Mr. Henry's classes; we are just note-taking a lot—he doesn't really put us in groups for anything. The field trip, I thought was very different. . . , like a different way of learning because we are normally just in a classroom, like reading out from the textbook. In school, you're not really required to think. . . yeah, not [thinking] to your full potential. You could think a lot more than they [sic] made you.
- Jane: I don't think I've been on a field trip since I got in High School.
- Winone: Yeah, not since Elementary School.
- Int.: How was the field trip different in that respect?
- Jane: 'Cause it's like visual learning, and in class you are just taking notes. It just doesn't connect as much as a field trip.
- Patricia: And we were actually doing something, like we were physically doing it instead of like in class we're just seating there like watching the board, taking notes.

Students self-selected to form groups of three or four for the purpose of completing tasks in keeping with the curriculum both at the nature center and on their return to the classroom. The groups were considered by Mr. Henry to be highly effective in terms of being on-task and working together collaboratively, and also in terms of working together in ways that would most likely result in meaningful learning. As a part of the instrumental, interpretive case study approach, three groups were selected for detailed investigation. Two groups were composed of three students (Groups A and B) and one group of four students (Group C). The social awareness, group tasks, and learning strategies of students and the groups in which they were embedded are summarized within each case and supported by a table of dominant tasks and social attributes of students. Tables 1–3 represent a summary of each group's characteristic task and social attributes. The authors subscribe to a contextualistic view of interpreting human experience. Thus, we consider that Tables 1–3 provide important context for the background interpretation of the data, particularly as they relate to the social role and status of the participants. The descriptors and ratings for each individual were agreed upon by the research team following intense deliberations and in consultation with Mr. Henry. In what follows, we do not focus on the detail or extent of differences among the groups in terms of their interactions. Rather we use the cases of Groups A, B, and C to elucidate the nature of metasocial elements of metacognition that we contend influenced the groups' learning processes. We propose that these metasocial elements of metacognition determine the nature of individual's as well as the collective engagement in completing a learning task in a group setting.

### **The Case of Group A: Winone, Jane, and Patricia**

Winone, Jane, and Patricia comprised an all-female group that was highly socially cohesive and task directed largely under the leadership of Winone. Among the Year 11 student population, they were perceived as a high social status group. As a group, they were primarily task orientated. That is, the key objective of the group was to complete the assigned field trip and in-class tasks. Their task and social attributes are summarized in Table 1.

**TABLE 1**  
**Dominant Task and Social Attributes of Students in Collaborative Group A**

Student	Task Orientation	Learning Orientation	Group Collaboration	Leadership	Participation Role	Friendship
Winone	High	Moderate-low	Moderate	High	Leader/ initiator/ task director	Close with all
Jane	High	Moderate	Moderate	Low	Moderator	Close with all
Patricia	Moderate	Low	Moderate	Low	Faithful follower	Close with all

The group culture was not strongly oriented toward approaches that might be considered to facilitate the meaningful learning of biology as there was minimal debate among members regarding their views on questions and concepts arising on the field trip, or on what was consequently written down as collective answers to task questions. As a collaboratively working group, they were on-task primarily with respect to the objective of completing the set activity as efficiently and quickly as possible. The following transcript is typical of their dialogue and exemplifies their talk during the field trip. In it, the students are determining what they consider to be the significant biotic and abiotic factors along their transect. The task also required them to make field sketches. The lack of critique or debate regarding each other's suggestions typifies their discourse. Throughout this dialogue, the students are busily writing down answers so as to complete the task requirements.

- Jane: . . . the significant biotic and abiotic factors of your zone.
- Winone: Biotic is living. Abiotic is not alive. Well, rocks, and mosses growing on the rocks. . . and maybe, like, critters live under rocks (others are writing as she speaks)
- Patricia: The wood. . . has the wood got bugs in it?
- Winone: Oh well, the trees are. . .
- Jane: (Interrupting) Some of the tress are dead.
- Winone: (Continuing). . . like (sic) shelter. . . produce, like (sic) oxygen.
- Jane: What else is dead?
- Winone: Dirt is abiotic.
- Jane: Dirt. . . and there's creatures living in the dirt, like worms.
- Patricia: What would wood bugs be?
- Winone: Biotic.
- Jane: Rocks and wood is (sic) abiotic, bugs is (sic) biotic. There's water. . . but there's no water.
- Patricia: What are those?
- Jane: Are they like maple leaves?
- Patricia: No, they'd be on a maple tree.
- Jane: What are they? (Still referring to the leaves)
- Patricia: Let's draw them.
- Jane: Already did.
- Winone: Oh, looks like we've got two different types of ferns. See!
- Jane: There's tons of kinds of ferns.
- Winone: Keep drawing!

Winone, Jane, and Patricia were all pleased and accepting of their group's membership and the close social friendships which they claimed to mutually enjoy. As Jane suggested, "We all know each other really well." As was the case with all three groups in the study, the members of Group A self-selected and enacted specific identifiable roles in relation to the functioning and operation of the group. While their personal awareness and decisions to enact these roles were not obvious as being conscious or predetermined during the field activities, during the postvisit interviews, the students reported recognizing each others' functional roles and status. Moreover, they identified these roles as ones in which they were most comfortable enacting, that is, each student held a strong preference for his/her role even after becoming more aware of their role enactment as a consequence of the interview process. In Group A, Winone was seen frequently by her fellow members as the one who set the pace and agenda of the tasks' facilitation and execution. The following excerpt from Group A's postfield center visit interview provides some insights into factors that shaped individual and group roles and the decisions that influenced the group members' opportunities for engaging in interactions that might have led to meaningful learning.

- Int.: Could you identify yourselves as having unique roles in your group?  
 Winone: I know what their role is. . . 'cause me, I'll start a question. . . I'll start thinking really hard, and then I'll think of an answer and I'll write it down, and I'll be like "Next question!" And these two would still be, "Oh, what else?" And I was going, "Oh next question, next question!" I will really rush a job, because I think I have the answer. . . and I just don't think that there is anything else to it. . . but these two are careful thinkers.
- Patricia: Yeah, like more independent.  
 Winone: Yeah. And they'll want to make sure that they have done a thorough job.
- Patricia: Yes.  
 Winone: Yes, for sure, I rush through tests and stuff. . . I'll just go "Oh yeah, those are really good answers."
- Jane: [laughs] Winone just goes at her own pace, but we are there just to slow her down
- Winone: [laughs]
- Patricia: I think if Winone wasn't in the group, if it was me and Jane, it would have been a lot different.

Both Patricia and Jane complied with the directions by which Winone charted the group's activity and function. Patricia and Jane were metacognitively aware individuals who each had a deep appreciation of the group's underlying social identity and character and the rules guiding the nature of interactions and discourse between group members that were congruent with that character. They both frequently declared that they often had ideas that might contribute to the development of their understandings of the biology, but that they did not contribute those ideas for the sake of maintaining social harmony. In other words, their monitoring of the group as a social entity influenced their own strategy use and approaches to the learning task.

- Jane: Winone and I have been friends for a long time, and we always get into huge arguments, so I tend to give up. I just drop it [any controversial issue], but I always know in my mind that I'm right. . . I don't think she can ever change her mind. . . I figure I can just tell the teacher or someone else [what I think] [laughs]. . . it doesn't affect our

relationship. I know that's the way I relate to her. I know when she's gonna start an argument. I just know her really well, so. . . [Winone laughs]. I know how to deal with Winone in terms of the things I say or hold back.

Winone: Yeah, we know that if we're going to start an argument we'll just stop talking about it. . .

Patricia: For me, I just sort of observe and then think about it. I don't really talk to them about what I think about. I just sort of think about it in my head. . . when we were in groups and we were discussing something I could remember the times when I wanted to say something but I hesitated to say it and then someone else would just say something, so I just would not say it at all. I could notice that a lot, like [sic] on the audio [CD]. . . there was stuff that I was planning on saying in my head but I never actually said it. I take their ideas like inspiration and then I'll start thinking about their ideas more. And then think about mine. . . I didn't take the initiative to say it, I just thought it in my mind and I was like, "Ok, that's good enough I don't need to say it if I thought it already."

Winone: I think I'm probably the opposite of that. . . I probably say stuff without thinking about it [laughs].

Jane: Yeah, and I think I'm probably in the middle. I say things, but some of them I keep in my head and think about it, like Patricia does.

This excerpt reveals numerous issues pertaining to the students' metacognitive knowledge and self-awareness of (a) themselves as learners within this particular group context, (b) the strategies they choose to employ within the group to service task completion, learning, and group harmony, (c) their self-regulation of strategies they individually employed, and (d) the strategies that they considered other group members employed. In terms of the individuals' self-awareness of themselves as learners within this particular group context, all, when given the opportunity to reflect, appear to be highly aware of their roles and actions. Winone is aware of her role as group leader, setting the pace and course of the group strategy, which is predominantly related to task completion. She appears to be somewhat aware that both Patricia and Jane like to think more carefully about their ideas. However, she cannot see much merit in the strategies they employ and hence she pushes the task completion agenda to the detriment and minimization of potential higher order thinking and interaction that might have otherwise arisen. Interestingly, Patricia and Jane seem accepting of this group strategy and acquiesce for the sake of maintaining social harmony and consequent task completion. Jane makes deliberate choices not to contest the task-orientated direction or to challenge Winone's ideas with respect to the answers related to the task. Furthermore, she holds the view that even if she really believes Winone is incorrect, it makes no difference because satisfaction concerning correctness of idea can be gained by expressing these views to significant others elsewhere, as she stated, the "teacher or someone else." Jane expresses a sense of security from knowing that these ideas will be appreciated by significant others elsewhere, hence she adopts a strategy of not challenging Winone since in her mind, as she revealed, there is no personal risk in rejecting that which could threaten the group's social harmony and its progress toward task completion.

Patricia too is aware that she is keeping ideas to herself and not expressing them to others. Instead she internalizes the ideas and concepts she gains from the other group members and gains personal satisfaction from her developing knowledge without ever sharing this developing knowledge with them. She makes no attempt to challenge the direction of the group's

processes, seeing the need to maintain social harmony as vital in ensuring the group's smooth functioning. Furthermore, she declares that she does not need to contribute her synthesized thoughts. Rather, she feels that the action of thinking and internally evaluating newly constructed knowledge is sufficient and satisfying enough for her.

This evidence from Group A suggests that their discussion of ideas in ways which might promote collective development of meaningful learning and higher order thinking appear stifled for the sake of maintaining social harmony. In the case of Winone, the need to complete the task is a mediating and constricting factor. Winone, Patricia, and Jane all appear to be highly aware of their own self-control of the strategies they employ. Interestingly, these students' reflections in relation to group processes indicate reasonable levels of satisfaction regarding the group's performance.

It became evident that the social relationships the students enjoyed with each other was a substantial determinant that influenced strongly both the group processes and the nature of the possible learning that might have resulted from the activity.

- Int.: What's more important, the friendship that you have or the biology that you learned?  
[Students laugh]  
Winone: Our friendship!

The students suggested that it was of great importance to maintain their relationships with each other, and that this consideration informed them as to when it was appropriate to move from one question to the next in the field trip task, even when a disagreement arose.

- Int.: . . . there was some tension about that question as to whether the rattlesnakes lived in sand or not. . . and you're [Winone] saying "Yeah," and you're [Patricia] saying "No," and then all of a sudden you get to the point where you[all] say "Ok," and then you go on to the next task?  
Winone: Yes.  
Jane: If Winone wrote down that they only live in caves, and we'd have [the chance] to discuss it later, [that's when] I would put my hand up and say, "Well, they can live in sand." [On the field trip] I just keep my input in my head.  
Int.: You seem to be keeping track of your existing relationships between the three of you as well as the learning task about the Biology?  
Winone: Yes.  
Int.: Is that right?  
Patricia: Yes.  
Winone: Yes. If someone would say something and I knew it wasn't fully correct, but I kind of knew what they're thinking about, I wouldn't write it down, but I wouldn't say, "Oh that's stupid. Of course that's not right."

It is evident from this excerpt that the group members are considering their collective and individual actions from a number of perspectives: a task perspective, a learning perspective, and a social relationship perspective and that their individual and collective actions reflect such considerations. There is also an indication of parallel or simultaneous monitoring from both the social perspective, which continually assesses social status with a view to maintaining social harmony, and from the individual learning perspective. For example, Patricia described how she constructs new knowledge by listening to the conversations of the others and internally evaluates the viability of that knowledge. Furthermore, she

monitors the social status of the group and adopts a conscious strategy not to contribute her new ideas to the group for the sake of social harmony.

Based on our interpretations, we propose that the students' conscious need to maintain social harmony among the group members was a prime consideration governing these individuals' behavior to the detriment of their engagement in higher order thinking processes with meaningful learning in mind. They have knowledge of this matter and report how they monitored it and how it influenced their interactions and discourse. We see the learning considerations as subordinate to the task considerations, and social relationship considerations strongly influencing group decisions, roles within the group, and the learning strategies employed. The group's actions gave the impression that they were highly on-task and highly collaborative and efficient, but unseen internal dynamic factors and what we consider metasocial elements of students' metacognition influenced the group's function and constituted barriers to maximizing opportunities for meaningful learning and higher order thinking.

### The Case of Group B: Kam, Yule, and Jeff

Kam, Yule, and Jeff were an all male group directed via the consensus-style leadership of Kam. Kam was highly collegial and moved the group in directions characterized by high-task orientation and the use of approaches consistent with facilitating meaningful learning of biology. Their task and social attributes are summarized in Table 2. Kam, Yule, and Jeff, all selected to constitute their group. They were all happy and accepting of the membership of the group because it comprised those with whom they had close social, enjoyable relationships. The particular roles they selected each contributed differently to the group's function and operation. While Kam self-identified and was identified by others in the group as the leader, Yule was seen as a contributor and refiner of ideas, and Jeff the assistant to the group. Table 2 presents a summary of Group B's dominant task and social attributes, determined, as with Group A, via the research team's deliberations and in consultation with the biology teacher.

The following transcript is typical of Group B's dialogue and exemplifies their talk and interactions during the field trip. In it, the students are determining what they consider to be the significant biotic and abiotic factors along their transect. The management of the discussion by Kam is evident as is the explanatory role of Yule. Jeff only contributes when prompted to do so by Kam.

**TABLE 2**  
**Dominant Task and Social Attributes of Students in Collaborative Group B**

Student	Task Orientation	Learning Orientation	Group Collaboration	Leadership	Participation Role	Friendship
Kam	High	High	High	High	Leader/ involver	Close with Yule/ moderate with Jeff
Yule	Moderate	Moderate	Moderate	Low	Idea giver/ idea refiner	Close with Kam/ moderate with Jeff
Jeff	Low	Low	Moderate	Low	Assistant	Moderate with all

- Kam: Which of the factors are most significant? I don't know. The trees?  
 Yule: Sure. Yeh, OK. The trees.  
 Kam: The trees. I don't know. The insects? What else? Jeff?  
 Jeff: That's it I guess.  
 Kam: (to Jeff) And then, why do you think this? Because. . . ?  
 Yule: (questioning the question) Why are the trees most significant?  
 Kam: Yeh.  
 Yule: Umm. How can I explain?  
 Jeff: You wanna write it down now?  
 Yule: They're most of what we've found. They're all around here.  
 Kam: Yeh, they're growing everywhere.  
 Yule: Yeh.  
 Kam: They're everywhere.  
 Yule: Yeh, trees take up most spaces.  
 Kam: They take up most land. (pauses) (to Jeff) Alright, do you have anything to add?  
 Jeff: I have, for abiotic, that soil is the most important. . .

The following excerpt from Group B's postvisit interview to the field center provides insights regarding the metasocial elements of the students' metacognition that shaped individual and group perceptions of individuals' roles and influence their engagement in meaningful learning.

- Int1.: What roles do you think you were each taking in the group?  
 Kam: I was somewhat a leader. I started off the discussion and then ended the discussion by referring to our thoughts. And then I wanted a new question [attended to] by stating the question and then asking other people their thoughts. . . I was somewhat the leader, but they were also contributing.  
 Yule: I think it is just naturally Kam's personality. He likes to have control and then Jeff is someone who, if someone asks a question, he'll contribute. We don't really pick other people to say something. Kam takes the role of being more dominant. I've been friends with him for a long time, he really likes to talk. . . he's not the kind of person that just shies away.  
 Kam: I would say something, and then I would ask Jeff or Yule, "Do you agree with my decision?" And then after that, if he didn't, then he would say something, and then I would think of his reasoning, and then I would say, "Oh, this might be right," and if I don't think my reasoning is right, then, [I would] go towards his and start trying to understand his view. And, I think it [this process] was good, because I would understand what he was trying to say and what I was trying to say and I connected the two and I came up with a decision. . .  
 Int1.: So, when you think about how you worked together, what are your roles? What do you do? If you were to say, "My job title in this group is. . ." What would it be?  
 Yule: Like, Jeff contributes. I am not someone who starts off the idea, the discussion. . . someone else starts off the discussion and I contribute to it.

- Int1: How does that benefit the group? What are you doing that makes this group work?
- Yule: With my ideas we can discuss. . . if one person just has his own ideas and the other person says nothing, it wouldn't be much of a discussion and then the project wouldn't be as good because it is better to have everyone's idea and everyone contributed, to have a good project.
- Int1.: And what do you think Kam does with that stuff that you give? What do you see him doing with it?
- Yule: He usually agrees with it. . . and he would think about it.
- Int2.: Jeff, how did you feel about it and what did you learn about the way that you think?
- Jeff: I didn't really think that much about it, if someone would ask me a question, I would just answer it. . . that's what I did practically all the time. . . I guess I am kind of like an assistant—I just gave them my answers and collaborated with them.
- Yule: I am not someone who starts off the idea, the discussion. I am someone, someone else starts off the discussion and I contribute to it. . . maybe I am a refiner of ideas. . . I'm not the type of person that just wants to be the leader. I'd rather contribute.
- Int1.: So, you're comfortable in that role and you like it?
- Yule: Yeah!

Kam was metacognitive in that he was aware of his own thought processes and strategies for learning as well as the group's, given his declarations that he was highly reflective of others' thoughts. He tested his personal reasoning and ideas with others' critique and had an overall strategy to construct the best possible solution to the problems posed by the learning task through a process of managing rational group consensus. All members of the group were content with their roles within the group and perceived themselves as making important contributions to group functioning and learning. Kam's monitoring of the collective and individual actions at the task, learning, and the social relationship levels is demonstrated in his conscious and declared strategy of pausing frequently to allow and encourage group members to contribute their ideas. Kam was aware of his own strategies as a learner, his personal desire and orientation to make the group an effective learning group, and indeed the appreciation of others' capacities to contribute. He was also aware of others within the group insofar as he perceived that they were listening to his expressed thoughts. This interpretation is based on Kam's testimony and his high orientation toward task, learning, and group collaboration as proposed in Table 2.

- Kam: I wanted them to give me their insights and I wanted them to be involved. I didn't want them just to go through the task not learning anything. I wanted them to understand. . . [to] give me the real insights, give me the real thoughts. Not just to whip [sic] through it. So I thought if I be like the leader that I could make them learn somewhat better. . . make them contribute more and make them be involved more. When they didn't answer anything, that's why I paused 'cause I didn't want just myself to give them my thought; so I thought, why not just wait until they give me their thoughts and then expand on that.

Kam's objective was oriented toward initiating, encouraging, and monitoring socially oriented learning discourse commensurate with meaningful learning of biology. As with Group A, there is evidence of simultaneous monitoring by the students of the social

condition of the group. This monitoring influenced the nature of any discussions that might lead to higher order thinking. Those discussions and related cognition utilized and reinforced friendship among the group members.

- Int.: What's most important, the friendship or the biology? How important is harmony in your group?
- Kam: The friendship? They're both important. . .
- Yule: [interrupting] We think friendship is much more important.
- Int.: Would there be a point where you would stop arguing to maintain the friendship?
- Yule: Yep (very quick to agree) If it gets intense. I think I would protect the friendship
- Jeff: Yeah, I think friendship is more important than biology.
- Int.: Does friendship affect how you learn biology and the way you think and act when working in your group?
- Kam: Well, I think it does, like, I connected with these guys maybe more than some other kids in my class, so when I was discussing with these guys, Yule and Jeff, I connected with them so I went more [deeply] into the question. . . if I was with people I didn't know, I would contribute, but I don't think I would be a good group leader. . . I would probably give my ideas and express my thoughts but I wouldn't be a leader.

Yule placed high value on group social harmony. This is evident in his assertion that if he perceived group exchanges about the task and learning were to become "intense," i.e. disagreeable, he would default to interactions with his fellow group members that would maintain group social harmony. Once again, this group exhibits some reluctance to engage in critical discourse that might adversely affect group harmony, however not to the same extent as in Group A. We also note Kam's simultaneous monitoring of these actions as being related to his efforts to be service the group's successful completion of the learning task as well as being related to maintaining social harmony.

Kam stated that who he is within a group context influences the kind of thinking in which he engages. Friendship was a key factor that enabled him to operate a consensus-style leadership that was considered by them to be fruitful to the learning of the group. There appears to be tentative evidence for the existence of an unconscious tension between the group's view that disagreement over discussion points should be avoided if it was to challenge social harmony even though such discussion might facilitate meaningful learning. This notion is explored further in the case of Group C.

### **The Case of Group C: Norma, Sally, Jessica, and Alice**

As with Groups A and B, Group C was highly collegial in character and oriented toward task completion and approaches that they believed facilitated meaningful learning of biology. Just as with Groups A and B, Norma, Sally, Jessica, and Alice each self-selected to constitute their group, and all were happy and accepting of the group's membership given the close friendships they shared. They had all known each other since the eighth grade, shared interests, and had regular social interactions with each other outside the classroom. It was apparent from the interview that all members wanted to be seen as holding equal social status. Furthermore, they were reluctant to acknowledge that the role, contribution, or opinion of one member might be more significant to the functioning of the group than that of another.

In their fieldwork, they interacted in a way that suggested that they each was willing to listen and give equal privilege to what the other group members were saying and there is little if any evidence of critique or review of each other's comments and ideas. In this short indicative excerpt, the students are in the process of considering whether moss is a significant biotic factor along their transect and whether sunlight influences its location. It is evident that ideas are sometimes proffered in a rather random manner from individuals. Despite the distribution of moss being quite random along their transect, and this being evident, students accept a questionable view rather than looking to clarify their position, even after one of them, Jessica, questions what is proposed. We suggest this provides evidence for the inclusive and generally noncritical nature of their interaction.

- Sally: Look at the moss.  
 Norma: It seems to be wrapping itself around. . . the trunk.  
 Jessica: But. . . some of them don't seem to have any. . .  
 Sally: (interrupting). . . maybe it protects them from the weather and things?  
 Alice/Norma: Oh, yeah. (agreeing)  
 Jessica: Look at that tree. There's no moss around the trunk. . . it's all on the branches and stuff (sic) it's all like (sic) hanging and stuff (sic).  
 Sally: Would you say it's more in the shade then the sunlight?  
 Alice: I don't know.  
 Norma: Yes, 'cos those trees, like (sic) there's moss on one side but not on the other.  
 Sally: There's the sun and there's no moss on that side (sun facing).  
 Jessica: So do you think. . . So wait, are we saying, the sun equals the moss or are we saying. . .  
 Norma: No, the other way around.  
 Sally: No, sun; no moss.

(Students move onto another topic and begin writing their answers)

Table 3 represents a summary of Group C's dominant task and social attributes determined in the same manner as for Groups A and B.

As was the case with Groups A and B, the members of Group C enacted particular roles that contributed to the functioning and operation of the group. Again, these roles were identified by the group members as being those with which they were comfortable. In Group C, Sally was seen as an initiator of discussions that rallied the group to task-oriented action. She did this through the provision of ideas that were catalytic to initiating other group members' contributions. Jessica was considered a builder of ideas, whereas Norma was self and group identified as a clarifier of ideas. Alice was self and group identified as the group monitor of tasks as well the focuser of discussion and the member who directed the connecting of information from the field trip back to existing biology content. Although these roles might suggest an effective and on-task learning group, testimonies from individual group members indicated otherwise, as is highlighted later. The following excerpt from Group C's postvisit interview provides insights about the group's perception of its members' roles.

- Int1.: What do you think your roles were in the group?  
 Norma: Well, I was answering questions. . . I remembered when I listened to the audio [CD], people were saying "Oh, what's this?" and I was trying to explain it and make it more clearer; even [in relation to] what the questions [on the task] were asking. I brought possible answers too.

- Int1.: Were you clarifying questions and ideas?  
 Norma: Yes!  
 Int1.: Sally, what was your role or roles?  
 Sally: . . . to throw ideas out. . . I remember Norma clarifying things and it always felt other people could clarify things. . . that's why I was asking questions and breaking the ice to get things going. I guess I just throw things out when there's silence. I just wanna [sic] get it going again.  
 Int1.: So you are pushing this group along?  
 Sally: Yes.  
 Int2.: An ice breaker?  
 Sally: Yeah.  
 Norma: We like use her [Sally's] suggestions to start us off.  
 Sally: Yes, exactly!  
 Jessica: Yes, she gives us a place to start.  
 Alice: Yes [agreeing].  
 Int1.: How did you see yourself Jessica?  
 Jessica: I was definitely not a starter, but I think I had to think about Sally's ideas and how she started and then how Norma clarified things and made them clearer. And I like built onto it and tried to put it all together.  
 Int1.: Clarifier and connector. You said that before, didn't you?  
 Jessica: Yes!  
 Int1.: Alice?  
 Alice: I was kind of [sic] like Jessica, but I was trying to connect their ideas more to Biology. If they'd say something that had nothing to do with Biology then I would take their ideas and try to connect them to the Biology.  
 Int1.: So you were bringing them on task, focusing them maybe? [The others nod enthusiastically] Is that ok? Well, you all nodded, did you notice that she was focusing ideas?  
 Sally: Yes.

There was a high degree of consensus regarding the group's perceptions of the enacted roles of members both individually (self-declared) and corporately (their views of each other's). The extent of satisfaction of the roles within the group was acknowledged by all members:

- Norma: Well I think that in those roles we feel very comfortable, and we are happy with them because they're easy [to undertake].  
 Jessica: I agree with that, we're happy with it because we're comfortable and we're familiar and so we know what we're doing and it's a regular thing.  
 Sally: I think the perfect 10 would have been staying in our roles, but at the same time being more versatile and taking bits of the roles that other people had, and trying to fit in that too. Like keeping the same roles, 'cause, like Norma said, we're comfortable with them that's what we're used to. . . but maybe Alice could have tried to throw out more ideas.

As with Group A, there is evidence to suggest that the Group C students' social relationships that they shared was a factor influencing both the group's collaborative processes and the shaping of the kinds of learning resulting from their collaborative engagement.

**TABLE 3**  
**Dominant Task and Social Attributes of Students in Collaborative Group C**

Student	Task Orientation	Learning Orientation	Group Collaboration	Leadership	Participation Role	Friendship
Norma Sally	High	Moderate	High	Moderate	Clarifier of ideas	Moderate/close to all
	High	High	High	High	Idea giver/discussion initiator/“leader”	Close friends with Alice/moderate with rest
Jessica Alice	Moderate	Moderate	High	Low	Sense maker/builder of ideas	Moderate/close to all
	Moderate	Moderate	High	Low	Sense maker (biology content)/task monitor	Close friends with Sally/moderate with rest

- Int.: Would you consider it easier to not contest ideas within the group comprising people with whom you have close relationship?
- Sally: Yes, in this activity if Norma said something that I disagreed with, I probably wouldn't even tell her, I'd just think to myself, "Oh I don't really agree with you," but I won't ever say "What! Would you say that!" or "That's wrong," mostly because I respect what she thinks, but also, "Is it really worth fighting [about it]?"
- Jessica: Yes, if it's something that, not that it doesn't matter, but that won't affect us that much, then it's not worth bringing that out. . . It's better probably just to keep it to yourself. But if it's something that is actually worth marks or that will affect something, then you would probably bring it out and discuss it.
- Sally: That was something about this activity. . . we weren't getting marked on it, so everyone was really open and we didn't really feel limited. We would write anyone's ideas down because we didn't want to hurt that person's feelings, but we wanted to be included. But had there been marks; like grades are important to me and I think they are important to everyone here, I know I would have probably said more. . .

This excerpt suggests that both Sally and Jessica are highly aware that they keep ideas to themselves and choose not to verbally express them to others. They suggest that they make no attempt to challenge the direction of the group processes, to challenge one another's ideas, or to engage in critical discussion. As in Groups A and B, the need to maintain social harmony appears to be highly influential in determining group dynamics and discourse. Noteworthy for this group, and absent for Groups A and B, were students' views of the limits to which the maintenance of social harmony would be the key influence on the nature of their interactions. A key issue was the view that assessment and grades act as moderators on how far the maintenance of friendships will be a key determinant of interaction and discourse. Again, however, our interpretation is that the potential for collaborative construction of knowledge and for meaningful learning is stifled for the sake of maintaining social harmony. The students are aware of this and consider it a benefit to the group on this occasion. However, they appear to appreciate neither the potentially detrimental consequences of these actions nor the potential benefits of more appropriate actions in relation to more meaningful considerations of each others' ideas.

Like Group B, the members of Group C declared that who they work with in-group contexts influences the kind of thinking they engage. Friendship was a key factor enabling them to operate a consensus-style group dynamics that was what they deemed fruitful to the group's overall learning and progress.

- Int.1.: How do you decide what to say and what not to say?
- Jessica: Well, if it's logical and I am sure of the answer then I say it. But if sometimes I am not that sure of the answer and then I won't say it. . . I'll just go with what other people think. . . when I am not sure at all, then I will keep it to myself and I won't bring any idea out.
- Sally: I think it also depends on who you've got around. . . the four of us, we all know each other. . . but had I been in a group with some people I didn't know as well, I wouldn't be as confident giving all these answers. Because I know these people, they would not make fun of me or about my ideas and opinions. But had it been people I didn't know that well, I know for a fact I wouldn't have given as many ideas.

- Norma: Yes [agreeing].  
 Jessica: When you work with people that you don't feel comfortable with  
 Sally: [completing Jessica's sentence]. . . it makes all the difference.  
 Norma: Yes.  
 Sally: In the classroom setting I know I don't say as much, but when I'm just between [sic] a few people I am easily able to say whatever I want.

From this excerpt, we note again that tension exists between (a) the students' beliefs that close personal rapport and strong social relationships between group members equates to and facilitates a highly effective learning group and (b) their reports that verbalization of ideas and discussion of those ideas is restricted for the sake of maintaining group harmony and personal friendships. Hence, as a learning community, Group C might also be considered somewhat questionable in its functioning, despite individual member's well-defined roles that could and in some cases did promote meaningful learning. Group C also portrayed the outward signs of a group that was highly on-task, highly collaborative, and efficient. However, the metasocial elements of students' metacognition awareness that the students could clearly articulate, influenced group functioning and opportunities for meaningful learning and higher order thinking were again evident.

## DISCUSSION AND CONCLUSION

This study demonstrates that, even among highly collegial and collaborative student groups that might be deemed effective by teachers and are constituted in ways consistent with recommendations from the literature on effective collaborative group work (e.g., Davis, 1993), there exists underlying metasocial or shared (group) metacognitive factors that can adversely influence and shape cognition and collaborative learning processes. Metacognition is traditionally viewed as executive mental processes that service learning and task action through individuals' knowledge, control, and awareness of their own learning processes. Furthermore, traditional views of metacognition have considered individuals' simultaneous monitoring of task and learning outcomes but have not explicitly accounted for or demonstrated evidence of students' simultaneous monitoring and awareness of learning, task, and social dimensions at both individual and group levels. This study reveals that in addition to this traditional individual-centered perspective, there exist other metacognitive processes and metacognitive knowledge that service the collective and individual actions of group members on both learning task and social relationship levels. We propose that students are highly aware of their social status and the group's social condition, that they monitor these conditions carefully, and employ strategies that concurrently service both the task and social relationships. We see these metacognitive processes as often operating in parallel or simultaneous with those reflecting traditional perspectives of metacognition.

The examination of the three case groups illustrates the presence of barriers to discourse that might lead to meaningful learning and higher order thinking. These barriers are not immediately obvious from observations of seemingly on-task behavior of student groups and their members. The interpretation of data from these case groups sounds an alert regarding the kinds of assumptions that teachers and educators make with assurances about the power of group work to promote meaningful learning among groups, even those who appear to be highly on-task, highly collaborative, and efficient. This challenges a widely held assumption that group on-task behavior necessarily implies the manifestation of meaningful learning of science in learning contexts such as field trips, the value of which is often unchallenged in science education circles.

This study reveals important insights about unseen internal group dynamics and students' metasocial awareness that influence group functioning to maintain harmony and that manifest hidden barriers to meaningful learning and higher order thinking. The maintenance of social harmony is seen in this study as an endemic factor that persistently influences students' behaviors, decision making, cognitive processes, and discourse. Furthermore, the need to maintain social harmony is often at the expense of group members' willingness to engage in discursive argumentation, critique, consideration of multiple perspectives, offering alternative ideas, all of which are recognized as precursors and/or pathways to meaningful science learning and the engagement of higher order thought processes. The extent to which social harmony might be maintained and/or challenged is influenced by intrinsic and extrinsic contextual factors, which on the basis of our analysis we suggest to be (a) membership and peer relations (internal) and (b) assessment (external) in those instances where the task is not considered to be assessed or of assessment value, forces that drive social harmony. Through the aid of the modified stimulated reflective recall of self, i.e., by listening to their own discourse within their groups (Anderson et al., in press), students were able to clearly articulate their role identities and thinking processes within the group and also articulate in detail the extent and manner in which such roles and functions contributed to group activity. Moreover, they are able to identify and influence deliberate social and cognitive strategies they employ to the service of maintenance of group harmony and the management of the own learning and task function.

Bianchini (1997) has called previously for teachers to pay greater attention to the role of intellectual status as a factor influencing students' participation in group work and has noted the problematic nature of this little attended to influence students learning. We suggest that also problematic is the influence of social factors such as the need for group members to maintain harmony at the expense of thinking and behavior that might lead to deep learning. The findings of this paper further highlight and complicate the role of teachers in mediating group activity and suggest that science educators might increase their attention regarding the role that the factors identified in this paper play in mediating group discourse and individual cognition.

We propose that science teachers and science teacher educators need to appreciate more fully (a) the extent to which students are metacognitively self-aware of their own roles and the roles of others within groups and (b) the potential for this awareness and sense of self-role within the group to influence cognition both positively and negatively. The study speaks to the importance of groups and their members being empowered to operate in autonomous and emancipatory ways as well as in ways that maintain social harmony. It is evident from this study that an unconscious tension exists between the belief that is widely held in education circles that close personal rapport and strong social relationship are necessary for and also equate to highly effective discursive learning groups, against the self-declared actions of withholding ideas and avoiding argumentation for the sake of group harmony. Clearly there is a need to consider providing opportunities for students to revise their metasocial metacognitive knowledge and to provide guidance for them in such endeavors.

The majority of the metacognition literature suggests that developing students' metacognition will unquestioningly lead to improved cognition and learning outcomes. However, some authors, e.g., Gunstone (1994) and Thomas (1999), have drawn attention to the notion that all students are metacognitive to some extent and that it is the quality of their metacognition and its adaptiveness for the context within which it is enacted to influence learning that also need to be understood and accounted for. In other words, interventions aimed at enhancing metacognition need to account for the contexts within which students learn, and this includes the social context (Thomas, 1999). We suggest that, in keeping with

the findings of this study, the metasocial elements of students' metacognitive knowledge require explicit attention by teachers so that students can be more aware and in control of their relationships and behaviors in learning settings so as to maximize their opportunities for learning success. Accordingly, we propose that there is a need to focus on developing students' knowledge, control, and awareness of more than just that part of their metacognition related to the development of conceptual understanding; a perspective that has been and remains prominent in science education circles over the past few decades. We argue that such explicit teaching for the future development of students' metasocial metacognitive knowledge would propagate notions that (a) differences of opinion are important points for discussion in science-learning settings, (b) students need to appreciate that debate on contentious matters can benefit learning of all group members without compromising social harmony and friendships if undertaken appropriately, and (c) science itself proceeds on the basis of conjecture and debate between science colleagues. We propose that it is important for students to be taught skills and to develop attitudes and dispositions that enable them to engage in the critical discussion of ideas and information, and that it is not appropriate to assume that such skills will automatically develop or that students will be willing to engage in such discussion if it has the potential to threaten the social fabric of the group. This is an area of science education that we consider to be underemphasized and in need of attention.

Our concern is further fueled by the fact that the students in this study were in the second last year of secondary school, with little time to develop such skills and attitudes before finishing that level of schooling. We are not aware of what training these students may have had regarding the practices of collaborative group work or the development of skills of, for example, argumentation and debate or related dispositions but suggest that if they had received such training it had not produced the intended outcomes. In some ways, given the students' declarations regarding the infrequent experience of field and group work these findings are not too surprising. However, given what we know from past studies in group work and in science education in general, we speculate that our findings might not be isolated to this class of students.

Despite our aforementioned concerns, our analysis of the data uncovered examples in Groups B and C of how some of those groups' members' enacted their metasocial metacognitive knowledge to facilitate productive interactions between members. In these cases, individuals and especially Kam were aware of the thinking processes of themselves and other group members and sought to mediate productive discussion to facilitate task completion and learning. Still, our position is that such enactment had limits to the extent to which it was employed, and that its enactment was constrained by students' concerns with the maintenance of social harmony which they highly valued. In this way, students' awareness of the social conditions of the group and its members and their behaviors toward each other, based on their metasocial metacognitive knowledge, do play an important role, i.e., that of ensuring conflict does not occur. It is widely acknowledged in the adolescent psychology literature that friendships are important in the teenage years and that adolescent friendships are characterized by increased understanding, self-disclosure, and common interests and are formed on the basis of interpersonal relations, individuals' physical attributes, and levels of achievement (Hartup, 1983; Heaven, 2001). It is also well established that friendships serve important socioemotive functions, and that adolescents without friendships may suffer stress and low self-esteem (Cotterell, 1996; Hays, 1988). Therefore, it is not too surprising to us that students might make decisions to maintain friendships and the associated social capital in preference to engaging in discussions related to enhancing their science learning. This might be especially the case if such discussions might result in conflict between group members, and in doing so potentially compromise their social relationships. Further research studies across the contexts of science education including field trips and

in other contexts such as science laboratories and everyday classroom group activities have the potential to further inform the science education community of the influence of such metasocial metacognitive knowledge on students' individual and group learning process and hence their potential and actual learning outcomes. We also propose that interventions be designed and implemented and their effects studied so that we might begin to build a repertoire of pedagogies that focus on the adaptive enhancement of students metasocial metacognitive knowledge and its enactment as well as other elements of metacognition that are known to enhance science learning.

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