Communications

Co-operation, Silence and the Quest for 'Cool' Ideas

MICHAEL D. HARDY

Verbal interaction is often recognized as the source from which co-operative groups draw their power to facilitate mathematical learning. Although discourse is a (if not the) major catalyst for learning within a co-operative setting, neither language nor social interaction is limited to the spoken medium. Accordingly, there is no reason to assume that limited verbal interaction prevents members of co-operative groups from serving as positive influences on one another's learning. This claim is partially based on my experience as a member of a co-operative group in which speech was often sparse. Hence, reflection on our interactions may support broadening the traditional conception of a successful co-operative group.

The context

Here is some background information about our group, its synthesis, and the context of our interactions. We came together as a result of our enrollment in a mathematics course for prospective secondary teachers that focused on problem solving: every participant was assigned to a group to solve selected problems. Students were expected to share, explain and justify solutions or potential solutions within and across groups. Likewise, each person was to have a copy and a brief written explanation of at least one of the solutions generated by her or his group.

Our team consisted of two females, Grace and Jennifer, and two males, Michael and Rory. Grace and Michael were about five years older than Jennifer and Rory, who were then twenty-one years old. We could all be described as able learners. Additionally, Grace had an engineering degree and Michael a master's degree in mathematics. Accordingly, our group was rather atypical when compared with most of the groups in the class, but then so were our problem-solving interactions.

Reflections

Silence was commonplace in our group, particularly in the early phases of the problem-solving process. As I reflect on my own problem-solving tendencies, one reason for my avoidance of talking was wanting to think about the problem, to understand and conceptualize it. Moreover, when trying to think, I find ongoing verbal discourse rather annoying as it tends to break my concentration. Consequently, I avoid speech not only to facilitate my efforts to make sense of a problem, but to avoid impeding others' efforts to do so. Rory echoed this position, "Talking may have slowed our thought processes", and everyone indicated that during the initial phases of problem solving they were likely to become absorbed in individual thought. Therefore, it is reasonable to conclude that we tended to delay conferring as a group until everyone had made sense of the problem being investigated.

A desire to familiarize ourselves with a problem prior to attempting to solve it was only one reason for the preponderance of silence during our problem-solving interactions. A colleague has suggested that the presence of an individual with more experience in mathematics may have been initially intimidating to the other team members. Jennifer alluded to some other reasons, stating:

> We didn't discuss a problem until everyone worked it (or attempted to work it) their way

We all agreed that speaking was generally postponed until one of us generated an idea that might resolve the problem at hand. However, we not only wanted to solve the problems, but we wanted to be the first to solve them. Thus, there was an element of competition within our problem-solving interactions. We concurred on this point, but Grace articulated it when she proclaimed:

> We all wanted to have the cool idea.

One effect of this mild competition was that it magnified our tendency to defer talking. Accordingly, our becoming a co-operative group in the richest sense of the term was delayed by interaction between our competitiveness and our desire to internalize problems. However, Rory stated that:

> The competition helped motivate me to stay on task with the problems

So it did have some positive influence on our interactions.

Jennifer and Grace's comments above highlight not only competition but pride as an influence on our problem-solving interactions. In addition to the avenue of competition, our pride manifested itself via desire to solve problems as elegantly as possible and thereby both impress our colleagues and preserve our images of ourselves as mathematicians. We also delayed talking while we each strove to create a 'cool' solution for the problem at hand.

Not only were we mildly competitive with one another, but we competed against the problems themselves. Jennifer indicated this in relating that she:

> wanted to try it [a problem] myself and conquer it

This was a sentiment that we all felt. However, in expressing her desire to 'conquer' problems, Jennifer also highlighted a shared drive to solve problems simply because they existed. This aspect of our personalities is closely related to pride, competitiveness and motivation. Moreover, these traits are and were mutually enhancing amplifing both the frequency of silence in our problem solving and our sense of individual accountability.

While pride, competition and motivation all contributed to our tendency to remain silent, they do not exhaust the list of contributors. Why did we want to impress each other and why did each of us wait to speak until she or he had a promising idea? Mutual respect was another reason for our actions. Having the 'cool' idea was a means of gaining the respect of our teammates, which was valued because we each respected each other: for instance, we all stated that we had delayed in articulating ideas in order to avoid

wasting the others' time with ideas that would quickly prove profitless.

Although silence was characteristic of the initial phases of our investigations, it was present at other times and for reasons other than mutual respect, competition or pride. Rory commented:

> Some groups needed everything written. They couldn't visualize, so they needed more talking to communicate their ideas

Grace echoed his claim by asserting that:

> This group was one of the better groups I've participated in because we didn't have to explain background material. We could communicate on the same level.

Our background knowledge and understanding of problem-solving strategies were quite compatible which reduced the need for speech.

Despite the prevalence of silence in our problem-solving interactions, we did influence one another's problem solving. Besides the reasons mentioned above, Grace reported that she was occasionally influenced by:

> looking over someone's shoulder.

Similarly, Rory observed that:

> There was quite a bit of non-verbal interaction. You could tell when someone was getting excited about a problem or grasping an idea. You could tell when they were getting frustrated and so you could decide whether or not to go down that path

In her turn, Jennifer asserted that she initially found my tendency to slow down and think about a problem frustrating, but:

> When I saw where it was getting you, it pushed my satisfaction [with my approach to problem solving] back

As for myself, I was influenced by all three of my partners. Very early in the course, Jennifer presented a simple and elegant solution to a problem, which reminded me to seek out such solutions, even if a solution had already been obtained. A little later, Rory made use of a geometric approach involving circumscribing an existing figure within a semi-circle that he introduced. Consequently, I kept in mind the possibility of introducing various figures or making use of inscription or circumscription (see the postscript).

We did not always solve problems individually and then share our solutions, but our abilities to resolve problems independently limited the frequency with which we collaboratively generated solutions. It was during one of these efforts that Grace motivated me to persevere more in the face of tedious calculations by her solving a problem by completing some daunting calculations and making some clever substitutions that were inspired by a solution plan proposed by a member of another group. We did influence one another's problem-solving strategies: however, this influence generally showed up in our future problem-solving efforts rather than in our approaches to the problem at hand.

Conclusion

In summary, unusually large parts of our problem-solving interactions throughout the course were dominated by silence. There were a number of reasons for this, among them pride, competition, mutual respect, a desire to "conquer the problem", the need to internalize problems and a limited need for speech. Even so, neither the frequent periods of silence nor the mild competition prohibited communication, which occurred both verbally and non-verbally and was facilitated by a range of talents, mutual respect and compatibility of both relevant knowledge and thought processes. Likewise, the frequent periods of silence did not prevent us from resolving problems or from serving as positive influences on one another's learning.

Although communication is both an essential aspect of co-operative endeavors and can be a powerful catalyst of learning, and although the progress and interactions of a group that engages in sparse dialogue should be closely monitored, limited verbalizations do not *preclude* the occurrence of interactions which facilitate learning. Accordingly, educators need to take care to construct concepts of successful co-operative investigations that are versatile enough to allow *some* groups that engage in limited verbal interaction to be described as successful. As the above reflections suggest, the power of co-operative learning does not lie *exclusively* in verbal discourse; it is the quality rather than the frequency of what is communicated that fosters learning in co-operative interactions.

Postscript

To illustrate one instance of an influence one had on another, here is an occasion where Rory influenced me to consider the possibility of inscribing, circumscribing or introducing figures more frequently. During one of our earliest problem solving sessions, we were assigned the following problem

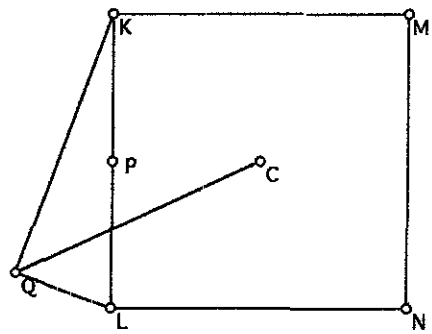

Figure 1

> Let C be the center of the square constructed on the hypotenuse KL of right triangle KQL. Prove that CQ bisects angle KQL

Initially, we each tried to resolve the problem individually, and the class period ended before anyone had obtained a solution. At our next class meeting, we shared the solutions that we had generated. I do not recall how many of us solved the problem, but I do remember that I thought Rory's solution to be both brief and elegant. He solved the above

problem by introducing a circle with its center P at the mid-point of segment KL.

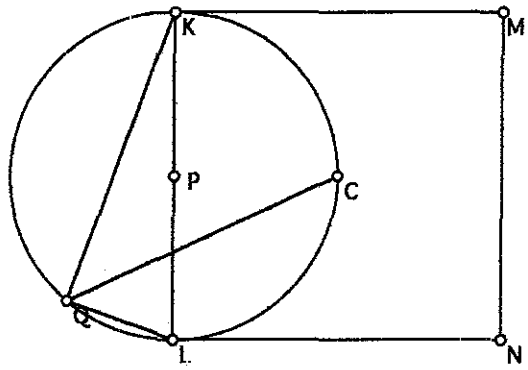

Figure 2

The essence of Rory's argument was to inscribe angle KQL in a semi-circle, note that the center of the circle would be the midpoint of segment KL and that the center of the square would be on the circle, derive that the measure of angle KPC = 90 degrees, and notice that the measure of angle KQC was one half that of angle KPC, = 45 degrees
Due to my appreciation for Rory's method, I often wondered whether inscription or circumscription of existing figures would help me solve problems. I did introduce figures fairly frequently, and I believe that my tendency to do so was strengthened by Rory's influence.