ELIS Classroom inquiry
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Deepening individual students' reasoning and summarising in Geography and Mathematics through teacher questioning and talk

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Abstract

This study details an approach to developing effective communication for student learning through the application of teacher talk moves. The results demonstrate that teacher talk moves are effective in guiding students to engage in extended talk related to the subject content. The authors discuss the approach to developing learner talk in the classroom through teacher talk moves and also the importance of reflective teacher dialogue to make this a sustainable practice.

Introduction

Two secondary school teachers attended the ELIS course 'Opening Up Talk for Learning in Subject Classrooms' (OUTLSC), where they studied a range of teacher talk moves to facilitate productive academic discussions. The teachers identified classes which had students who were not active in classroom interactions. Together with the ELIS team, the two teachers carried out an inquiry into their classrooms to explore how they could develop effective communication for learning with their students. The two teachers embarked on an inquiry cycle based on the work of Timperley, Wilson, Barrar, and Fung (2007) to critically self-reflect on their classroom interactions and examine how they could encourage student participation. The teachers developed approaches to building focussed academic talk, getting their students to build on each other's contributions, support their comments with reasoning, and elaborate on points raised by their classmates.

Literature Review

The current study is based on the underlying position that spoken language is central to learning and that it is essential to have focussed talk around the content being taught. Resnick, Michaels, and O'Connor (2010, p. 163) highlight that 'without disciplined talk, scientific, mathematical, and humanistic knowledge remains unused'. The authors also add that special care is needed to create educative environments to nurture and develop reasoned discourse (p. 172). Similarly,

Mercer (1995) describes the school environment as a place for students to share and develop their own thoughts (p. 4). One approach to developing student learning through effective talk in the classroom is the use of teacher talk moves. The teacher talk moves covered in the ELIS OUTLSC course are adapted from the work of Michaels and O'Connor (2012) and Zwiers and Crawford (2011). The talk moves are organised in a broader framework of focus areas, and examples of frames for prompting are given for each talk move (see Table 1 below).

Table 1

Teacher Talk Moves and Example Frames for Responding from ELIS's Opening Up Talk for Learning in Subject Classrooms course

Focus Area		Talk Move	Example Frame for Prompting
1	Voicing and clarifying students' ideas	Seek clarification	Can you elaborate on X?
		Re-voice for verification	So you're saying that…
2	Listening closely to other students	Ask student to restate another student's contribution	What do you think X was saying?
3	Deepening individual students' reasoning	Probe for reasoning or evidence	What's your evidence for that?
		Challenge a student's statement or assumption	Are you sure that …?
4	Engaging with each other's reasoning	Elicit students' views on other students' ideas	What do you think about what X has just said?
		Guide students to build on other students' contributions	Who can add on to the idea that X has just shared?
5	Consolidating discussion points	Get students to summarise or consolidate	What have we discussed so far?

Methodology

Teachers need to engage in dialogue that is designed to improve teaching and learning (Annan, Lai, & Robinson, 2003) in order to improve their practices of engaging students in effective learner talk. The approach for this study is based on the work of Tan and Lee (2014), who developed and trialled a set of questions for teachers to reflect upon their classroom interactions with a view to improving the learning outcomes of their students. Their study was informed by the work of Walsh (2003) and Mann, and Walsh (2013), who researched how teacher interactional competence can be developed through reflective talk which is mediated with data from the classroom. In the current study, transcripts of classroom interaction were examined. Transcripts are an appropriate form of data to examine teacher and student talk as they can enable teachers to learn and understand the reality of their interactions and motivate deep learning (New Zealand Ministry of Education, 2008, p. 54).

Teacher inquiry cycle

The teacher inquiry cycle was adapted from the teacher inquiry and knowledge building cycle by Timperley et al. (2007) and took the following pattern:

1. Identifying learner needs
   The teachers had a discussion with the ELIS team and reflected on their students' needs. From this discussion and their own reflections, they identified talk moves which would meet the needs of their students.

2. Lesson planning
   The teachers planned a one-hour lesson. In their plans, they indicated the intended teacher talk move(s) for different lesson segments.

3. Lesson implementation and data collection
   The teachers conducted their planned lesson. The ELIS team made video recordings of the lesson and the video recordings were subsequently transcribed.

4. Focussed data analysis
   The ELIS team analysed the transcripts. The transcripts and a set of reflection questions were emailed to the teachers for their reflections on the classroom talk. These questions included 'Did I actively build on my students' responses by probing for reasoning or evidence, or inviting them to explain or justify their ideas?' and 'Could I have interacted differently to encourage student contributions more or help steer the discussion in a more purposeful way? What exactly could I have said instead?'

5. Reflective dialogue
   The teachers discussed their analyses and reflections with the ELIS team, who prompted the teachers to describe and critically reflect on their classroom talk.

Each teacher participated in two teacher inquiry cycles. The cycles enabled the teachers to evaluate and reflect upon their use of teacher talk moves and make changes to their classroom practices.

Excerpts of classroom interaction from the first lesson

Figure 1 shows an excerpt from Teacher 1's first lesson on the subject 'Applying the shoelace formula to find the area of figures in Coordinate Geometry'. The classroom talk has Teacher 1 doing most of the talking and the students have limited input. In the right column are descriptions of the talk.

T	… For each point, if you have the x- and y-axis, you are able to write down where is the rough position. Doesn't have to be exact, as long as you are confident of what is the order of the points over there. Ok, so if you look at this working here, there is no diagram, diagram is not part of the working, doesn't matter but if you somehow manage, if you get it wrong – there's a half chance right? Can be the other way also. If you get it wrong, you will get a negative answer instead. So those of you who have tried it, you would have realised it. So let's get it out of the way: although the sketching is not part of your working, it *is* important for you to try and find out where each of these points is for your own reference. So those of you who didn't do it, please fill it in later. Now we go into the working. Here	The teacher talk consisted of long explanations with very few questions posed to the class. The odd questions posed were also not followed up for a response by the students.

	the working from [S1] is correct. So if you look at this here, she has chosen P as the starting point. … And then she happened to go in the order correct so it is P, Q, R and S so she went on P, Q, R and S repeating P so this is correct. From here, make sure that all the negative signs and all the pairing is done correctly. She's put in all the very nice brackets also. The big one, middle one, small one – all there already. Ok, so she put this in and the answer 52 is correct. Incomplete.	
All	Unit square.	
T	Unit square. … So you all have practised applying this formula for area. This will apply for any figure that is made up of straight line segments. So we have seen the two special examples – triangles, quadrilaterals… I think the papers will not be too cruel to you all. But even if you go to more like five, six, seven – same idea. Entirely the same idea. Ok now we are done with the area portion. Thank you [S16]. … Now you all see the next part after area right…	Student input for the classroom discussions are limited to single words or very short responses.
S16	Three stars.	
T	Three stars. What does this star mean? I will explain to you. Can you look at example 28 at the back? … We have come through two weeks of talking about coordinate geometry. There are many many different parts of it. Do you remember what the very first thing we started off with was? … Running up the slope…	
S17	Gradient	
S18	Length	
T	Actually she's right. That was not answering the question. We started with length first, then after that we went up to gradient, talked about equation. Then we went to the A Maths portion – midpoint, parallel lines, perpendicular lines and so on. All this, so far we have seen it section by section in order to learn the formulas and how to apply. But we are able to treat this altogether also ok? They are not just one cousin and one cousin not related – no. They are together and for this example 28 here, the final one, we will see that actually all these concepts can come together in one massive question. Mental sum: how many points is this question worth?	The students do not ask questions nor build on each other's responses.

Figure 1 *Excerpt of classroom interaction from Teacher 1's first lesson*

Figure 2 shows an excerpt of Teacher 2's first lesson on the subject 'Food waste'. There were no extended exchanges between the students and Teacher 2, or among the students themselves. Teacher 2 did not use open questions that could allow for multiple perspectives. As a result, the students had little opportunity to contribute different views or add on to other students' contributions.

T	OK now that you've seen the video, Ok… What is happening? Can somebody give me a brief summary of what you just saw? … [S1]?	The teacher repeatedly asks

S1	They're eating the leftover food.	short, focussed questions which require a specific response.
T	… OK they're eating the leftover food because…?	
S1	Not enough money?	
T	Ok, they don't have enough money? And? …. How do they get the leftover food?	
S1	Uh from the waste…. [inaudible]	
T	OK so who's collecting the food for them? …. Who's the man? … Is he like a friend of the family? Is he the main breadwinner of the family? Who is he?	
S1	Uh, the father	
T	Ok, possibly the father of the family, trying to provide for his family. Ok so… what are some impacts that you can identify from this video? Uh, [S2]?	
S2	[inaudible]… can spread diseases…	The students give limited responses that do not consist of full sentences.
T	Right, we look … focus on what we saw in the video – the diseases spreading and all that comes later. But, just now what you saw in the video … What are some impacts that we can identify?	
S2	[inaudible]… malnutrition	
T	Malnutrition, OK yes? So they're malnourished. Can you look at your worksheet? Tell me which one of the boxes represents malnourishment?	
S3	Third one	

Figure 2 *Excerpt of classroom interaction from Teacher 2's first lesson*

Reflective dialogue on the first lesson

Both teachers identified that they could have used specific talk moves to address the students' learning. Teacher 1's class was a Secondary 3 Maths class with 24 students. He understood that he did not give his students enough opportunities to demonstrate reasons for their answers, and often he ended up giving the answers before the students were challenged to do so. He wanted the students to probe for reasoning and evidence; and for the students to build upon each other's responses which would also demonstrate their active listening. As a result, Teacher 1 chose talk moves from Focus Areas 3 and 4 (see Table 1) to use in the classroom for the subsequent lessons (Figure 3).

Guide the groups as they are commenting and making their choice:

- Why do you think (comments on graph shape)?
- How would you improve on her graph?
- [If there are mistakes in graph features] What do you think went wrong here? How did you/she come up with this value?
- Do you agree with what she has said? Why or why not?
- [Comparing 2 graphs] What differences do you observe in these graphs?

Figure 3 *Excerpt of Teacher 1's lesson plan showing his selection of teacher talk moves*

Teacher 2's class was a Secondary 4 Geography class with 30 students. She articulated that the students were quiet in class, giving one word responses, and did not build on each other's output. She asked questions to probe for reasoning but did not set up the questions or expectations of the students. Therefore, the students did not contribute as expected. To address this, she decided to look at talk moves in Focus Area 3 (see Table 1) and incorporated the talk moves into her subsequent lessons (Figure 4).

Ask another group to comment on the discussion with the following talk moves.

- What do you think about what X has just said?
- Who would like to respond to X's idea and tell us why you agree or disagree?
- Do you agree/disagree and can you explain why?
- Who has a similar/different idea about how this works?
- What might be other views/solutions?

Figure 4 *Excerpt of Teacher 2's lesson plan showing her selection of teacher talk moves*

The teachers carried out lessons for a month, and used the teacher talk moves with extended interaction opportunities. After approximately one month, the ELIS staff carried out a second inquiry cycle with the teachers.

Results

The excerpt of the classroom interaction from Teacher 1's class (Figure 6) shows the impact of talk moves used with the students for approximately one month. The excerpt shows Teacher 1 engaged in reasoning with a student. There is a much more balanced distribution of talk, with the student being guided to demonstrate her reasons for a calculation. The excerpt also illustrates a shift in his teacher talk from extended monologues to focussed questions designed to lead the student to explain and support her reasons.

T	… Ok so once you're able to write this down for sure – it's $px^2 + qx + r$ – how do you proceed on from there? What are you doing?	Teacher explains less about the task and asks more questions to probe for student reasoning.
S1	I compare the coefficient… Then I'll be able to find the p, r and q values…	
T	Just by looking?	
S1	No, you have to compare. You expand this equation. … Then you compare.	

T	Can you show one example? What are you comparing?	The student's talk is in complete sentences, and she is engaged in an extended exchange with the teacher.
S1	You're comparing like… You want to know what is p right, and x^3 then… Like that – this one and this one.	
T	She's saying that compare x^3, so she's showing us what she's comparing.	
S1	This one and this one – compare.	
T	OK, how do you find q so easily? Most of your friends are stuck with q, so I'm very interested to know. So most of your friends are not too sure how the q came about.	
S1	… Oh because you get p right, so if you get p – so it's 2 times 2 which give you 4 – then you need 5, so 5 minus 4 is 1.	
T	Those of you who are stuck – did you hear that? … [S3]can you hear what she's saying? … Cannot then can you just raise your hand and tell her you cannot hear, cause otherwise she's wasting her effort also.	
S1	… Cause this one is 2, right? … Then the p is 2, right? So it's 2 times 2… Which will give you 4 over here. Then this whole thing is a 5, so it's 5 minus 4. It's 1.	
S2	How you get 4?	
S1	2 times 2… This one 2 times this one… [laughs]	

Figure 6 *Excerpt of classroom interaction that shows Teacher 1 probing for student reasoning*

The excerpt below (Figure 7) shows the changes in Teacher 2's classroom interactions. The opening lines illustrate Teacher 2's new practice of setting expectations for the discussions clearly to the students, which she had not done previously. By having these expectations made explicit, the students understood the expectations of interacting with each other, adding on to other student contributions, and doing so at specific points in the lesson.

T	Ok girls, we are going to start our discussion… Ok I'm going to set a little bit of the expectations. I know some of you have jotted down some things that you want to share about but I want this to be learning from each other, because there are two different cases studies that you're looking at. So once I pick a group to share about their discussion, I would like the other groups to actually ask questions and to clarify if you think something else – other issues you can talk about – please feel free to add in… [music plays in background] So as we start… not singing Edelweiss… Let's start with [S1]. [giggling] Ok, your group. What did you all find out? … Just talk about – briefly about – the strategy and then the success and limitations… The rest of you, can you all please listen?	The teacher asks questions to get the student to elaborate further on her response. In the first recording, the questions were less open-ended, with a focus on seeking set answers that could be found in the lesson materials.
S1	For the Ebola case, there was a presidential decree so that they can access the mobile phone records, so that they can check all the	

	people that were in contact with the Ebola patient, and then they can quarantine them also.	The student's spoken output is significantly more extended compared to the first lesson. As the student had been given time to consolidate her thoughts and write them down, she could elaborate in detail what she had found out in her group discussions.
T	OK…	
S1	Then those patients that were infected with Ebola, they also disinfected their house to prevent the spread of this Ebola. Private clinics also treated these people and also came to learn how to identify Ebola patients.	
T	OK so what are the roles that you all identified? Who played a part?	
S1	The government played the most part, like they [inaudible] implement the law so that [inaudible]	
T	So you feel as a group that the government implemented the strategy to track everybody's phones. Why did they want to track everybody's phones? What did they hope to find out?	
S1	People in contact with [inaudible]	
T	So like say somebody has contracted Ebola – they found out who's their circle – so that they can quickly go and treat them or see if they have caught Ebola as well. Ok… Any other strategies that… There was another strategy you said?	
S1	… They disinfect the house?	

Figure 7 *Excerpt of classroom interaction that shows Teacher 2 framing the expectations for the discussion and engaging in a deeper discussion with one student*

Discussion

The following section discusses the issues raised by the teachers from their experiences of using teacher talk moves to support student learning. Teacher 1 observed that the students started using talk for learning during their classroom interactions. For example, the students developed a habit of asking questions which engaged each other's reasoning, and not to just seek answers. Therefore, Teacher 1 believed that the students were now less reliant on him for answers and were instead more proactive in seeking to clarify questions. Teacher 1 also noticed that the students' confidence had visibly grown, with the students having a clearer idea how to present their solutions and express their thought processes. The students became better at standing in front of the class and speaking with more certainty. However, an issue Teacher 1 did raise on using teacher talk moves in the classroom was that it took more time than traditional didactic teaching which required less talk.

Teacher 2 believed that the students were more responsive in the second lesson and they independently gained knowledge from the spoken activities which she had planned and carefully set up. Teacher 2 also felt that she had become more self-aware of the types of questions she was using, and she was increasingly conscious of encouraging student responses to each other by using more wait time for students to respond.

With more time spent setting up the environment and the content than in the first lesson observation, Teacher 2 felt that the students were more confident in applying their knowledge. She also noticed that students came up with interesting ideas and started questioning why other

groups had other opinions during the student class presentations. She has now applied what she learnt from the inquiry to a separate Secondary 2 Geography class to make them think critically.

Conclusion

The results of this study illustrate that the infusion of teacher talk moves into lessons through the teacher inquiry and knowledge building cycle can be effective in developing effective communication for learning in secondary Maths and Geography classrooms. Student classroom talk practices can be developed to get students to engage with each other's reasoning, build on other student's contributions, and give reasons for their responses.

A future area of inquiry is to see how teacher talk moves can be applied to the Maths and Geography students of different ages. Both teachers have expressed their interest in exploring the impact of richer classroom talk on written test results and in finding out the feelings of students who experience new classroom practices of focussed talk in lessons. They will continue to obtain anecdotal evidence from their students over the rest of the academic year.

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References

Annan, B., Lai, M. K., & Robinson, V. (2003). Teacher talk to improve teacher practices, *set*, *1*, 31-35.

Mann, S., & Walsh, S. (2013). RP or 'RIP': A critical perspective on reflective practice. *Applied Linguistics Review*, *4*(2), 291-315.

Mercer, N. (1995). The Guided Construction of Knowledge: Talk amongst teachers and learners. Clevedon: Multilingual Matters.

Michaels, S., & O'Connor, C. (2012). *Talk science primer*. Cambridge, MA: Technical Education Research Centers (TERC).

New Zealand Ministry of Education (2008). *Ki te Aotūroa: Improving inservice teacher education learning and practice*. Wellington: Learning Media Limited.

Resnick, L.B., Michaels, S., & O'Connor, C. (2010). How (well structured) talk builds the mind. In R. Sternberg and D. Preiss (Eds.), *Innovations in educational psychology: Perspectives on learning, teaching, and human development*. (pp. 163-194). New York: Springer Publishing Company.

Tan, E. M., & Lee, G. (2014, November). *The classroom interaction teacher reflection tool (CITReT) for teacher professional development*. Paper presented at the 3rd Annual WSA-EC Forum, Singapore. PowerPoint retrieved from http://www.elis.moe.edu.sg/elis/slot/u54/news-n-events/past-events/wsa-ecforum2014/Presentations%20(Primary)/2.2b%20CITReT%20for%20Teacher%20Professional%20Development.pdf

Timperley, H., Wilson, A., Barrar, H., & Fung, I. (2007). *Teacher professional learning and development: Best evidence synthesis iteration*. Wellington, New Zealand: Ministry of Education.

Walsh, S. (2003). Developing interactional awareness in the second language classroom through teacher self-evaluation. *Language Awareness*, *12*(2), 124-142.

Zwiers, J., & Crawford, M. (2011). Academic conversations: Classroom talk that fosters critical thinking and content understandings. Portland, ME: Stenhouse.