Abstract ID : SYM050d

Title : The case teacher's approach to Bridging and the knowledge co-construction process around it – The researchers' perspectives

This paper presents findings from observations of the case teacher's unit of lessons that informed the development of the video cases and teacher participation in the online PLCs. A simplified version of Nassaji & Wells' (2000) IRF-discourse structure and the Mathematics Curriculum Framework (CPDD, 2005) reveals that the bridging from model method to algebra was done through 'discussion of problem sums' by purposefully and carefully building upon students' work using model method. The lessons followed predominant IRF structure where teachers' initiated discourse plays key role in developing students' processes, metacognition, and attitudes towards building connection between the two methods. Such classroom discourse patterns informed the development of viewing questions that scaffold teachers in viewing the video cases.

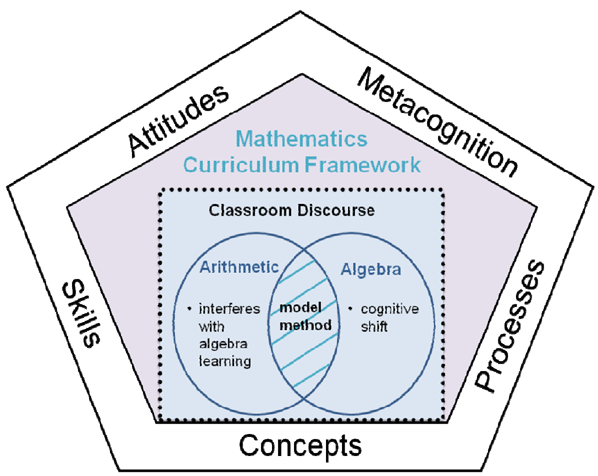
Introduction

Classroom discourse patterns have often been characterised by the Initiation-Response-Evaluation/Feedback (IRE/F) sequence, also referred to as triadic dialogue (Buzzeli, 1996). According to Cazden (1988), the IRE/F sequence consists of three parts; (a) the teacher asks a question or call upon a student to share; (b) the student responds to the teacher's query; and (c) the teacher comments on the students' response. This sequence allows the teacher to maintain tight control over the direction and momentum of talk, and provides the teacher with some information about students' knowledge.

Wells (1999) posits that teachers do not enact the IRF pattern of interaction in an inflexible, unquestioning fashion but rather, "the choice of the sort of follow-up move to make is a highly strategic one" (p. 262). Nassaji and Wells (2000) have designed a detailed coding scheme to characterise the functions of the teacher's 'Initiation' and 'Follow-up' moves to offer perspectives on the extent to which do both students and teachers co-construct understanding of a particular issue. This coding scheme is useful in defining the teacher's moves and to some extent, provides the basis for inference of the curricular objectives embedded in the moves.

Using an adapted version of the coding scheme by Nassiji and Wells (2000) and incorporating the Mathematics Curriculum Framework (CPDD, 2006) as an additional coding tool, this study examines the teacher's moves and learning intentions to characterise classroom interaction in the bridging process. The graphical representation of the conceptual framework for this study is illustrated in Figure 1 below.

Figure 1: The conceptual framework



Data analysis

The data from the video and audio records were transcribed. From this corpus of data, particular classroom data points which serve as telling cases were selected for analysis (Mitchell, 1983, 1984). These cases were meant to tease out patterns and themes and induce theoretical interpretations about contextual circumstances (Rex, 2001). Applying grounded theory, open coding was done to locate the core categories and identify the telling cases based on the pattern of classroom activity. The telling cases were defined by activity segments which depicted the how the teacher had conceptualised and contextualised 'bridging'. Three categories for the telling cases were identified– (i) going through model method; (ii) introducing algebra; and (iii) reviewing algebra homework.

Next, at the axial coding stage, general codes were first developed to identify the speaker, T – for the teacher; Cl – for multiple students; and different two-letter abbreviations to denote individual students. The teacher's actions and interactions were examined to explore similarities and variations and make links between the categories (Strauss and Corbin, 1998). It was noted that the spoken text in the teacher-whole-class discussion was embodied in a recurring type of rhetorical situation and corresponded with the 'triadic dialogue' or the Initiation-Response-Feedback (IRF) discourse pattern (Cazden, 2001). To indicate the process of the teacher questioning, student answering, and the follow-up move by the teacher, teacher's initiation was coded as 'I', students' responses as 'R', and teacher's follow-up as 'F'. If a student initiated, it was then coded as 'I(S)' and teacher's response as 'R(T)'. When the teacher responds to his own question, it is also coded as 'R(T)'.

On closer examination, the IRF structure showed a variety of forms and was recruited by the teacher for a variety of functions (Nassaji & Wells, 2000). This led to the coding of the teacher's moves to reflect the function in which the 'Initiation' and the 'Feedback' moves serve. Nassiji and Wells (2000) suggest that the teacher's moves are informed by the goal of the activity, a pedagogical purpose. Hence, the teacher's moves were further coded, analysed and interpreted in terms of their embedded pedagogical intentions.

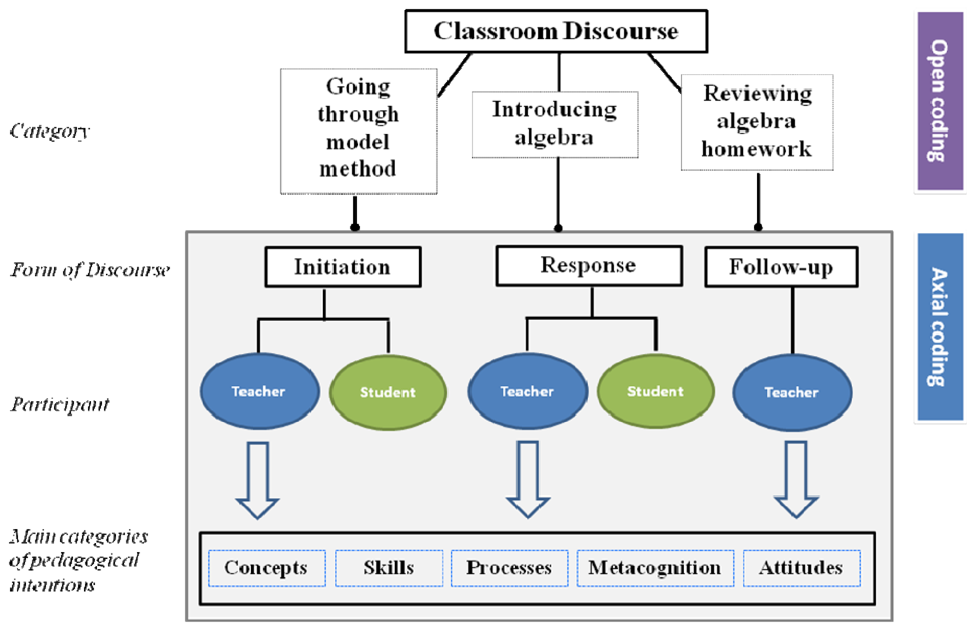
As mathematics teaching is guided by the Mathematics Curriculum Framework (Figure 1) and to provide a standard reference for understanding, the five curricular goals explicated in the framework were selected to characterise the pedagogical intentions of the teacher. Concept was coded is ‘C’, Skills as ‘S’, Processes as ‘P’, Attitudes as ‘A’ and Metacognition as ‘M’. Table 1 shows an example of the coding of the IRF pattern, the teacher’s moves and selective coding to define the teacher’s intentions.

Table 1: Coding of IRF pattern, teacher’s moves and intentions

	Text	**IRF**	**Teachers’ Move**	**Intention**
T	The way to do Maths, there are 4 steps. What is the first step? Yes, Eu.	I	Ask S to recall Polya’s 4-step p.solvg process	M
EU	[Mumbles]	R		
T	Do you understand the question? Do you think you can understand?	I	Prompt student	M
EU	[No response]	R		
T	3 sentences, 4 sentences in just one reading. Probably not. Then you will probably need to read it again and again and again. You will read it until you understand.	F	Encourage re-reading	A
T	So can you read the first line for me?	I	Focus reading (S)	M
Cl	Book A costs 30 cents more than book B.	R		
T	Alright, so we have a comparison. There are 2 books A and B. One is more expensive the other one is cheaper.	F	Identify thinking skill required	P

Through the application of grounded theory in the data analysis process, an analysis framework evolved. Figure 2 depicts the entire data analysis process discussed above.

Figure 2: Data analysis process using grounded theory approach



Findings

(i) Going through students' marked assignment as context for bridging

From the classroom observations and data analysis, it is found that the teacher used the marked assignments on the model method as the basis to anchor the bridging between arithmetic and algebra. Each lesson's focus was shaped by the teacher's prior knowledge on students' mistakes that he had gained from marking their work. Throughout the five lessons, the teacher would begin with going through the word problems which he had marked. He would ask the class to read the question in chorus to aid their recall. Next, he led the students to deconstruct the problem by focusing on the information in each sentence of the word problem. As he led them in talking through the problem solving process using the model method, he would reflect the model and the procedures step by step on one side of the board. In the presentation of the procedures, the teacher would often make mistakes deliberately and invite students to identify them. These mistakes were a reflection of those students had made. Once he was through with his explanation, he would instruct students to copy the model answer from the board. Then he would use the same problem to introduce algebra, starting by asking students to re-read the question. Next, he led the students to interpret the information in the word problem the same way he did for the model method and discussed the procedural steps. For every problem, he would get the students to define 'X' and interpret the rest of the information in terms of 'X'. He would then write the procedural steps on the other side of the board, arranging them side by side with the model method. But out of the six questions, there were only three where the teacher pointed out the connections between model and algebra as advocated by Cai & Moyer (2006). After the answers were derived, the teacher would again instruct students to copy the model answers. This was how the teacher had conceptualised and contextualised 'bridging' in his lessons.

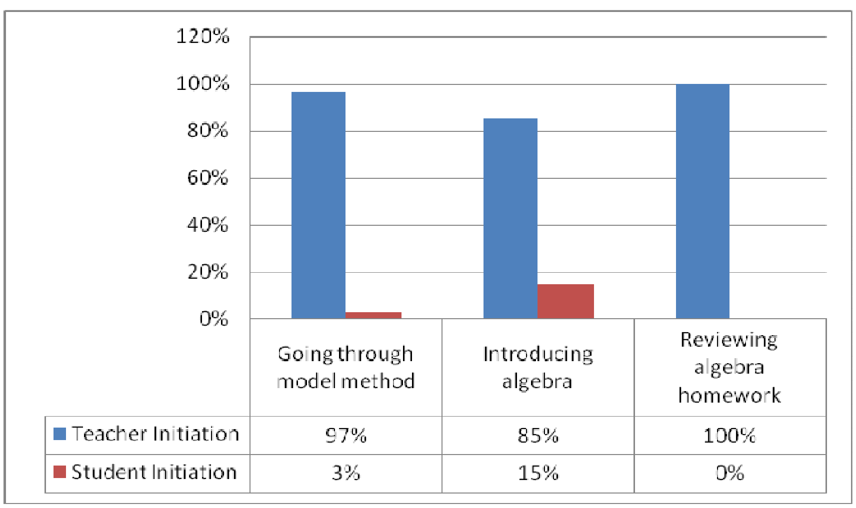
The way the teacher operationalised bridging, going through model method first, then introduce algebra, suggests that he deemed facility in the model method as a precondition to understand algebra. His chosen strategy – using going through students' marked work as a context for bridging – was implemented smoothly. This suggests there are indeed opportunities within the enacted curriculum where teachers can capitalise on to bridge arithmetic and algebra.

In reviewing the connections that this teacher made between the model and algebra, he showed that he was able to conceptualise the model as a pictorial equation and also point it out to the students. This would help students appreciate the underlying conceptual structure of the model and algebra (Ng & Lee, 2004). The deliberate arrangement of the model method and algebra side by side also seems to be an effective way to provide a visual comparison of the two methods. However, the profitability of this approach should be confirmed by further studies.

(ii) What the IRF structure reveal about the classroom interaction

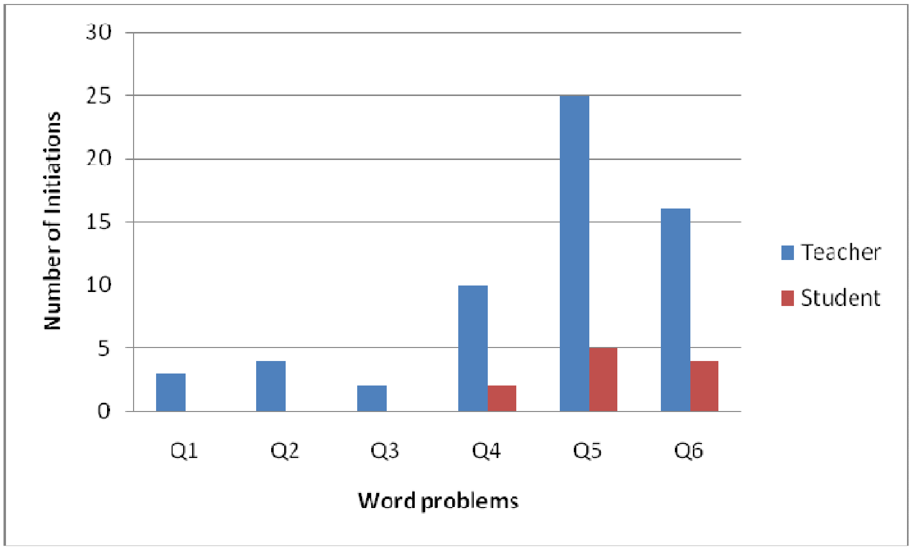
The intention of this study is to understand the form of discourse in each of the three lesson categories – going through the model method, introducing algebra, and reviewing students' algebra homework. Using the IRF structure to characterise the lesson categories, it is found that this triadic dialogue pattern occupied the largest portion of classroom discourse and most of the dialogue was initiated by the teacher. Though the IRF pattern is most prominent, there are variations in the different lesson categories. When the teacher was going through the model method, there were 3 student-initiated exchanges out of 105 exchanges, or approximately 3 percent. During the introduction of algebra, there were 11 student-initiated exchanges out of 71 changes, or approximately 15 percent. When the teacher was reviewing the algebra homework, there were no student-initiated exchanges out of 23 exchanges. Figure 3 below outlines the percentage of teacher and student initiation for each of the three lesson categories.

Figure 3: Percentage of teacher and student initiation in three lesson categories



It is noted that the highest number of student initiation occur during the introduction of algebra. As this is the main part of the bridging lesson, it is worthwhile to study the distribution of student-initiations across the sampled questions and the number of exchanges for each question within this category as illustrated in Figure 4.

Figure 4: Distribution of student-initiation among six questions



From the graph, the first three questions have recorded a relatively low number of teacher initiations, suggesting that the exchanges between teacher and students were not extensive. In the subsequent questions 4, 5 and 6, the pattern shows that student-initiation increase in proportion to the number of teacher initiation and there were also more exchanges between teacher and students.

Upon close examination of the function of students' initiations, it was found that they were mainly seeking clarification on either the presentation of the working or the procedural steps. Excerpt 1 shows the example of a student seeking clarification when the teacher was going through the procedural steps during the introducing algebra lesson.

<u>Excerpt 1</u>

I   T: What is 150? Whatever you say. 890 minus 510. 380 divided by 2, X is equals to?

R   Cl: 190.

F   T: 190. So you can write the statement this way.

I T: Is this not the same? Is the answer the same?

I(S) BH: How did you get it?

From the example above, it shows that the student was unclear about how the teacher derived the answer and he wanted the teacher to explain. If disregarding the student initiation, the pattern of discourse is typical of those found in all the three categories. However, the function of the initiation and the follow-up moves vary greatly. In the traditional IRE, the third move is evaluative in nature. But in the IRF proposed by Wells (1993), the third move is defined as teachers' reactions to "extend, draw out of the significance, or to make connections". In this study, the analysis of the third move attributes the form of classroom discourse more to IRF than IRE. The evidence will be discussed in the following section where the teacher's initiation and follow-up moves are selectively coded to analyse the pedagogical intentions behind these moves.

(iii) What the Mathematics Curriculum Framework (MCF) reveal about teacher intentions

The use of the MCF framework in the coding serves to illuminate the kind of curricular intentions that are embedded in the teacher's move. Basically, the coding using the five dimensions is applied to all teacher's moves, including initiation, response, and follow-up by the teacher. The moves are interpreted based on the descriptors listed in the MCF framework and are coded selectively. If a move is interpreted as not having any pedagogical intention embedded such calling upon a student, evaluating or confirming of students' responses and some others like those shown in the examples below, they are excluded from the coding.

Examples of moves not coded

T: So why didn't you raise your hand then first?

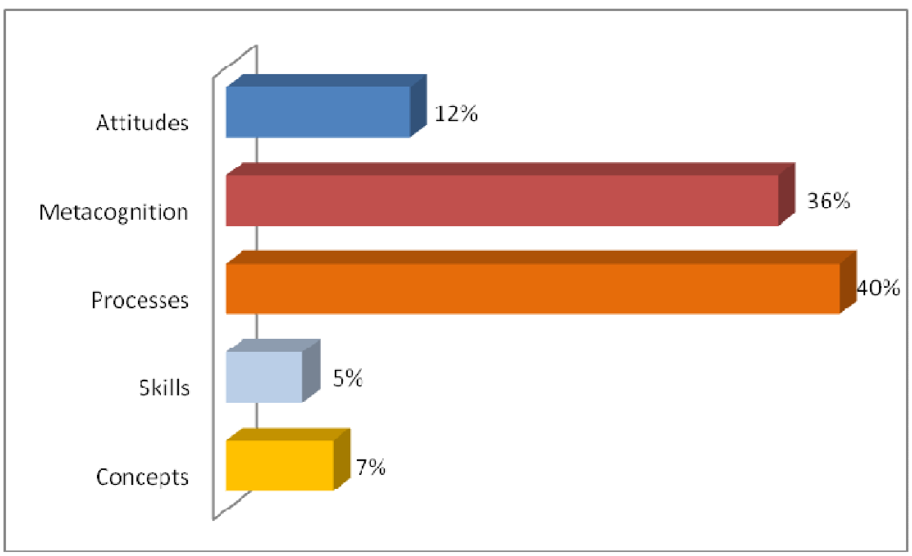
T: Again?

T: She is the damsel in distress. Can we have a hero to her rescue?

Some of the initiation and follow-up moves have more than one embedded pedagogical intentions. In this case, each intention is coded but if they address the same dimension, it will be considered as one count. In terms of interpretation, the context of the bridging lesson was considered. As the interaction was based on problems that students already had knowledge of, moves that aided their recall of the problem were coded as promoting metacognition.

Figure 5 shows the various pedagogical intentions found in the moves for the lesson category of going through model method.

Figure 5: Emphasis of curricular goals in going through model method



The findings show that the teacher had largely focused on the processes, metacogntion dimensions, which accounted for 40% and 46% respectively, followed by attitudes, concepts and skills, each accounting for 12%, 7% and 5% respectively. These findings contradict those that Yeo & Zhu (2005) have found which point to mathematics teaching often deals with routine procedural skills and basic concepts. However, it is important to note that depending on the context of the lesson, the pedagogical intentions can vary greatly. In this context, students had already been taught the requisite knowledge and skills and the teacher going through their marked work did so with the intention of enhancing the communication skills in Mathematics and their metacognitive awareness.

In contrast, when introducing algebra which required the construction of new knowledge, there was different emphasis of the curricular goals shown through the teacher's moves as illustrated by Figure 6. While the skills dimension was still the core focus, accounting for 31% in that lesson category, concepts and skills were given greater emphasis, each accounting for 21% and 19% respectively. This was followed by metacognition at 15% and attitudes at 14%. This suggests that the teacher acknowledged that students needed greater grounding the algebraic concepts and skills than in arithmetic. Findings in the previous section noted that there is a relatively high proportion of student-initiation in this lesson segment where students sought clarification on processes and procedures. This reflects that although students have learnt algebra, help is still needed to develop their ability to apply algebra in problem solving.

Figure 6: Emphasis on curricular goal in introducing algebra

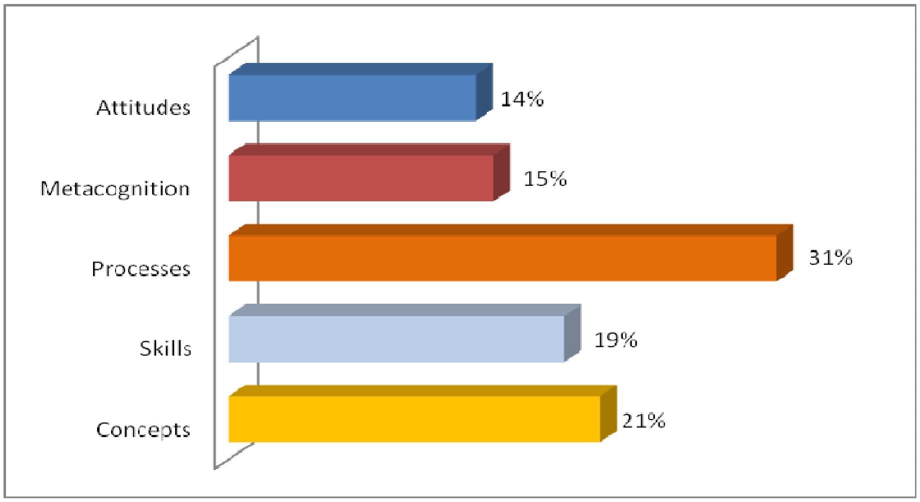
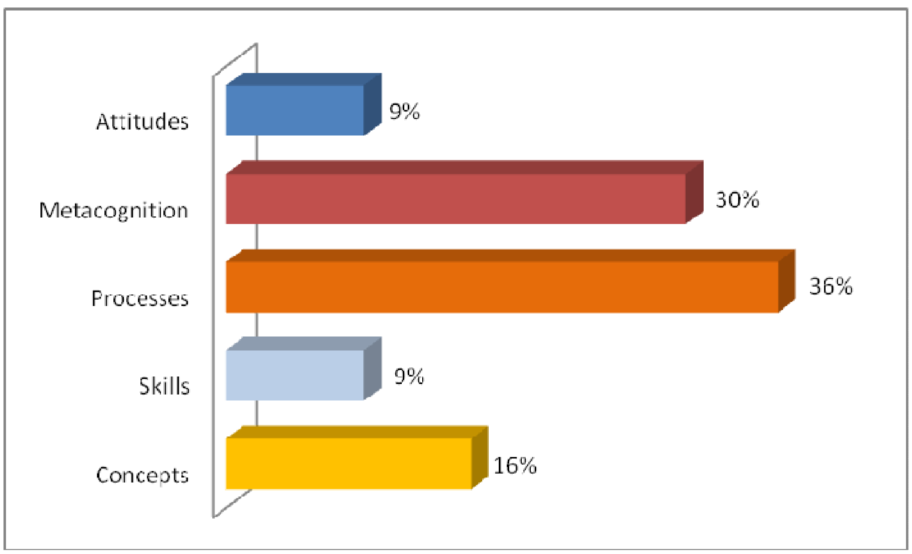


Figure 7: Emphasis on curricular goal in reviewing algebra homework



For the lesson category on reviewing algebra homework shown in Figure 7, the graph closely mirror the category on going through model method. Under this category, the teacher went through homework that was assigned on algebra skills and problem solving. The focus of the lessons was to highlight students' mistakes for learning purposes. In this case, there was a similarly strong emphasis in processes and metacogntion which accounted for 36% and 30% respectively, followed by concepts at 16%, skills and attitudes, each at 9%. The results seems to agree that pedagogical intentions that guide the teacher's moves when going through marked assignments are different from those that guide the introduction of a new topic. It may be inferred that at different stage of bridging arithmetic and algebra, teacher intentions would likely to vary but this would again depend on the context in which the bridging is situated.