LSP International Journal, Vol. 2, Issue 2 June 2015, 37–52

Value of Non-native Speaker Teacher Acts in the Second Language Science Classroom

Azian Abd Aziz, Abdul Halim Abdul Raof, Fauziah Ismail, Masputeriah Hamzah
Language Academy
Universiti Teknologi Malaysia

ABSTRACT

This study aimed to investigate actual non-native teacher talk in the second language (L2) science classroom and the value of the talk as perceived by students, who are English language learners. Twenty L2 science lessons conducted by ten non-native teacher trainees were analyzed for teacher acts. Feedback from the teachers was also obtained via stimulated recall sessions. Perceptions of the value of the teacher acts were obtained from sixty-one students via group interviews. The findings indicated that most of the teacher acts were identical to those occurring in other classrooms. Nevertheless, two of the acts, namely, overt repair and assist acts were newly identified acts generated by the teacher trainees, which suggest that some acts may be particular to specific classroom contexts. Students perceived certain acts, namely, the elicitation, follow-up, check, and conclusion acts, to be more valuable compared to others in aiding their understanding. Findings of this study offer a more realistic approach in implementing L2 science teaching and learning in the context where teachers and students are not proficient in the L2.

Keywords: Non-native teacher talk, second language science classroom, teacher generated acts

INTRODUCTION

Quantity of talk generated by teachers in the classroom remains a contentious issue. This contention is probably more apparent in science classrooms where active learning is advocated under the principle of constructivism with students developing knowledge through active engagement in the learning process, and teachers orchestrating students' learning experiences (Carin & Bass, 2001). The essence here is for teachers to engage students in extended and substantive talk in order to create meaning where students rather than teachers do most of the talking.

Nevertheless, there are unavoidable circumstances where teachers' oral discourse dominates. The most extreme scenario involves parts of the world where teachers are highly esteemed and hold the position of knowledge providers. In such instances, it would be both unrealistic and culturally inappropriate to reduce the quantity of teacher talk (Cullen, 1998). To a lesser extent, in classrooms which apply constructivist learning, teachers would still need to generate a large amount of oral discourse, particularly when topics are newly introduced. Obviously, talk generated by teachers continue to play a pivotal role in students' learning process as it is through teacher talk that students develop or reinforce concepts and ideas (Wittwer & Renkl, 2008).

Although studies investigating teachers' oral discourse are not new (see Sinclair & Coulthard, 1975), the current context in which talk is generated by teachers might warrant that the issue be revisited. The change in classroom context mainly stems from the fact that the English language has not only taken over the key registers of science (Kaplan, 2001) but has also become the communication language of significant scientific research both at the intra- and inter-personal levels (Charlton & Andras,

**Correspondence to:* Azian Abd Aziz (email: m-azian@utm.my)

2006). This has resulted in many Asian countries which had previously ignored the English language in favour of the vernacular language to promote the use of English as a medium of instruction in science and technology related subjects (International Herald Tribune, 2002). This decision raises the issue of English language use as the medium of instruction in science classrooms where English is neither the teachers' nor the students' native language (henceforth known as L2 science classroom or classrooms). This is because subject specialists, who were previously able to deliver the content effortlessly via the native language (L1) now have to grapple with the task of imparting the content knowledge via the English language (L2). Students, who are themselves English language learners (ELLs), instead of only having to concentrate on understanding the content of what is being taught, have to also understand the language in which the subjects are taught. This suggests that for the L2 science classroom to be effectively implemented, both the non-native speaker (NNS) teachers and students who are ELLs should be given appropriate and sufficient L2 training.

However, the type of L2 training that should be implemented to support L2 science classroom teaching and learning remains obscure. Yore and Treagust (2006) reported that suggestions related to classroom practice made in science teaching journals have not been substantiated empirically. Instead, the suggestions are mostly based on personal experiences and opinions. Relying on such materials could be both inaccurate and unsuitable. Inaccurate, as the language prescribed might not be the one which is naturally occurring in the target speech community. Unsuitable, as prescriptive materials are usually written for a native speaker audience, which NNSs might find difficult, incomprehensible or even offensive (Dubois, 1986).

There is thus a need to describe and profile NNS teachers' oral language in the L2 science classroom context, and to obtain feedback from ELLs on what facilitates their understanding for the purpose of making informed decisions in the L2 science classroom language training programmes. However, few studies have investigated actual NNS teacher talk in the science classroom and even fewer have looked at the correlation between NNS science teacher generated talk and ELLs' perceptions of the value of such talk. Hence, this paper aims to fill this gap.

Teacher Acts in the Classroom

Teachers influence the direction of learning (Hattie, 2008) where the oral instructional language generated by them in the classroom is at the heart of teaching and learning (Azian *et al.*, 2013). However, what talk do teachers generate in the classroom? In attempting to answer the question, perhaps it is best to look at Sinclair and Coulthard's (1975) seminal work on oral classroom discourse. They describe classroom discourse as being made up of five ranks comprising lesson, transactions, exchanges, moves, and acts, with lesson being the largest unit, and acts the smallest. Twenty-two acts, encapsulating the functional properties of the oral language in use, were identified. A diagrammatic representation of Sinclair and Coulthard's (1975) analysis of oral classroom discourse is illustrated in Figure 1.

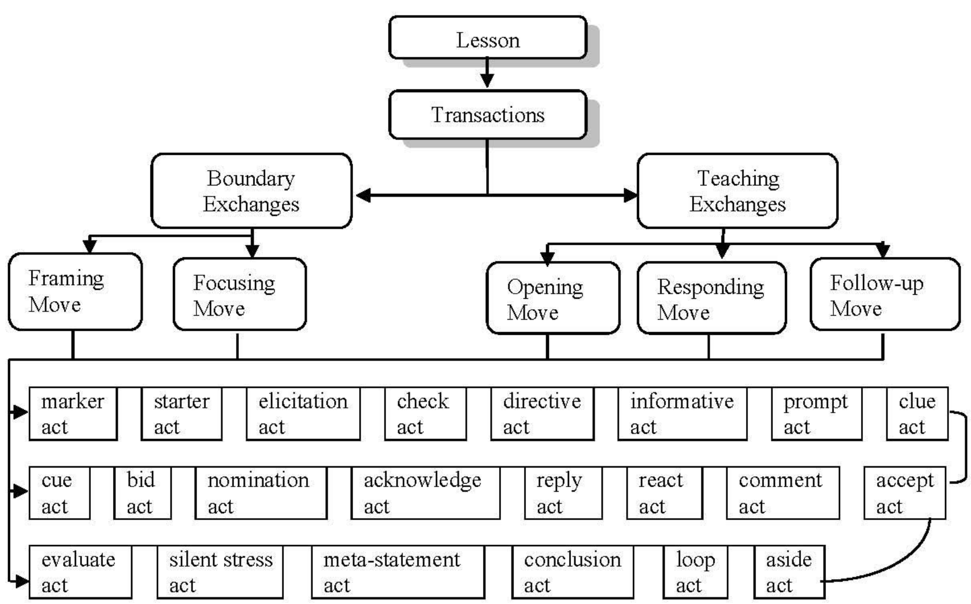

Figure 1 A diagrammatic representation of Sinclair and Coulthard's (1975) oral classroom discourse framework

More recent classroom discourse studies have made a departure from Sinclair and Coulthard's (ibid) descriptive framework in two aspects. Firstly, researchers are now selective rather than comprehensive, where only selected teacher generated acts are investigated. Secondly, the studies are analytical rather than descriptive, where rather than describing the 'what', the focus tends to be on 'how' teacher generated acts influence students' learning.

Due to the ubiquitous initiation-response-follow-up (IRF) classroom discourse pattern, probably two of the most investigated teacher generated acts are the elicitation and evaluate acts. On the one hand, teacher initiation which employ low-order thinking skill questions have been perceived to lack pedagogical value compared to higher-order thinking skill questions (Habsah Hussin, 2006). On the other hand, others have argued that an initial low-level question could be built upon in the teacher follow-up act to further enhance students' thinking and reasoning skills (Mortimer and Machado, 2000). Nassaji and Wells (2000) concur with this view and pointed out that an initiate-response-initiate-response sequence would promote an extended discussion, which is multivoiced (Jarvis and Robinson, 1997), thus resulting in the formation of shared knowledge. At this juncture perhaps it should be noted that not all follow-up moves culminate in teacher questioning. Cullen (2002) notes that apart from teacher questioning, the follow-up act could also be in the form of either teacher echoing, which is to ensure that the correct response is audible or teacher reformulation, which functions to provide the correct model of language usage to everyone in class.

Another much researched area of teacher act is teachers' use of discourse markers (DMs), which Sinclair and Coulthard (1975) characterise as the 'marker act'. Although DM studies tend to be explored in the context of tertiary academic lecture, these studies can be built upon by studies investigating classroom discourse. This is because classroom discourse may be more monologic rather than dialogic as generally perceived, as teachers have been found to do most of the talking (see Azian *et al.*, 2013). In general, studies suggest that DMs contribute towards making oral academic discourse more comprehensible (see Flowerdew and Tauroza, 1995; Khuwaileh, 1999)

The findings of classroom discourse studies have certainly been illuminating. However, the evolution of the education policy in Malaysia, and countries like Malaysia, requiring less proficient NNS teachers to use the L2 as a medium of instruction to teach ELLs, has generated a new teaching and learning context. Thus, this study aimed to answer the following research questions:

1. What teacher acts do NNS science teacher trainees (NNS-STTs) generate in the L2 science classroom instruction?
2. What are ELLs' perceptions on the meanings and uses of acts generated by the NNS-STTs in the L2 science classroom?

METHOD

Participants

Participants were ten non-native speaker science teacher trainees (NNS-STTs) and sixty one ELLs enrolled in the respective NNS-STTs' L2 science classrooms. The NNS-STTs were either Chemistry or Physics teacher trainees from a particular Public Higher Learning Institution undergoing their teaching practicum, whose native language are either Bahasa Melayu or Chinese. Teachers were selected using the purposive sampling method, and individual variables controlled in terms of content knowledge competencies, groups of students taught, aims and objectives of science subjects taught, and L2 proficiency levels. The ELLs were selected using the disproportionate stratified random sampling, taking into account gender and ethnicity. With disproportionate stratification, the sample size is not proportionate to the population size of the stratum. For instance, out of 30 enrolled students, where 28 are Malays, 1 is Chinese and 1 is Indian, the disproportionate stratified random sampling might not be able to include the Chinese and Indian student as a participant as they might choose not to participate in the study. Nevertheless, as far as possible, the sampling technique had included the different ethnic groups and gender of students, although disproportionately.

Research Data

In total, one thousand five hundred and twenty (1520) minutes of lessons were audio recorded, comprising two lessons from each participating teacher. The data were transcribed verbatim using existing transcription conventions (see Silverman, 2006). As the use of an audio recorder does not permit non-verbal interaction to be recorded, field notes were taken to supplement the recorded data, which provided context and setting to the situation (Patton, 1990). To gain further insights the teachers were each subjected to a stimulated recall session (see Gass and Mackey, 2000 for what entails stimulated recall) using audio recorded lessons together with their transcriptions as prompts. Data were also obtained from the sixty one participating students via group interview sessions (see Gillham, 2005 for an extensive discussion on group interview). As the focus was on obtaining feedback, both stimulated recall and group interview sessions were conducted in either English or Bahasa Malaysia, depending on the participants' proficiency level. Data obtained were then transcribed using a simple form of transcription using the sentence format structure.

Data Analysis

The primary data involving the L2 science classroom corpus were subjected to macro and micro analyses Analysis at the macro level was guided using Sinclair and Coulthard's (1975) description of the lesson and exchange ranks. The macro analysis was necessary as it provided context to data analysed at the micro level. Once completed, they were then subjected to a micro analysis involving coding the discourse into acts, again using Sinclair and Coulthard's (1975) framework. However, adhering to pre-determined functional categories in identifying the acts would result in two main constraints. First, there is no allowance for overlaps resulting from the multi-functionality nature of language. Second, acts which do not match the prescribed categories cannot be included. To overcome these constraints, the pre-determined act categories were supplemented with categories which were 'data generated'. This was achieved through the implementation of the conversation analysis approach in tandem with the context provided. The identified act categories were then quantified.

Coding at both macro and micro levels also followed the prescribed procedure of constant comparative method (CCM), which requires newly inductively coded data to be constantly compared with previously inductively coded data. This process is seen to promote internal validity and replicability (Lincoln and Guba, 1985) and is deemed to reach a saturation point when comparisons between the 'old' and 'new' codes no longer shed any new information (Boeije, 2002).

In analysing and coding stimulated recall and group interview data, the CCM principle was again adopted. Themes which were inductively derived were then triangulated with the L2 science classroom corpus analysis.

RESULTS

Acts Generated by NNS Teachers in the L2 Science Classroom

Analysis of the data revealed that acts identified in this study showed a high degree of correlation with the ones identified by Sinclair and Coulthard (1975), as the labels they formulated aptly reflect the generic teacher acts occurring in the classroom. Nevertheless, this study employed a more fine-grained analysis resulting in the inclusion of further sub-acts under certain main acts. In total, seventeen teacher acts together with the respective sub-acts were identified as shown in Table 1.

Table 1 Types, frequency and percentage of acts employed by NNS-STTs in the L2 Science Classroom

Rank	Act/Sub-act	Frequency (sub-total)	Frequency (total)	Percentage (%)	
1	ELICITATION		1501	21.13	
1.1	elicitation direct	708			
1.2	elicitation prompt	509			
1.3	elicitation repeat	175			
1.4	elicitation probe	69			
1.5	elicitation clue	40			
2	FOLLOW-UP		1232	17.34	
2.1	follow-up brief accept	398			
2.2	follow-up repetition	364			
2.3	follow-up reformulation	169			
2.4	follow-up reject	123			
2.5	follow-up elaboration	106			
2.6	follow-up give	72			
3	INFORMATIVE		1069	15.05	
3.1	informative content	850			
3.2	informative managerial	190			
3.3	informative meta-statement	29			
4	CHECK		1019	14.34	
4.1	check confirmation	598			
4.2	check comprehension	304			
4.3	check managerial progress	72			
4.4	check repetition	45			High Percentile
5	DIRECTIVE		524	7.38	
6	STARTER		420	5.91	
7	REPLY		309	4.35	
7.1	reply brief	166			
7.2	reply elaboration	126			
7.3	reply reject	17			
8	COMMENT		295	4.15	
9	NOMINATION		183	2.58	
10	MARKER		127	1.79	
11	ACCEPT		105	1.48	
12	CONCLUSION		91	1.28	
13	OVERT REPAIR		73	1.03	
13.1	overt self repair	69			Medium Percentile
13.2	overt other repair	4			
14	LOOP		61	0.86	
15	ASIDE		60	0.84	
16	CLUE		32	0.45	Low Percentile
17	ASSIST		3	0.04	
	TOTAL		7104	100.00	

Based on the total percentage of occurrences, the seventeen acts were grouped under the high, medium, and low percentiles. Four acts comprising the elicitation, follow-up, informative, and check acts, fall under the high percentile, with each respective total percentage of occurrences falling between the range of 14.36 per cent and 21.15 per cent. Nine acts, namely, the directive, starter, reply, comment, nomination, marker, accept, conclusion, and over repair acts fall under the medium percentile. The range of the total percentage of occurrences of the respective nine acts is between 1.03 per cent and 7.38 per cent. The remaining four acts, comprising the loop, aside, clue, and assist acts fall under the low percentile, with the respective total percentage of occurrences ranging from between 0.04 per cent and 0.86 per cent.

Further analysis of the 1 501 elicitation acts, revealed that 171 or 2.41 per cent were classroom management type questions, while 1 330 or 18.72 per cent were content related questions. As better understanding could be achieved through the process of negotiation occurring during questioning rather than through direct transmission (van Zee and Minstrell, 1997), on the onset, this figure seems impressive as it suggests the use of extensive content related questions in the L2 science classroom. However, further categorising the 1 330 content related questions into either closed or open-ended questions disclosed that 1 076 were closed questions, with only 254 open-ended questions. Closed questions are usually pitched at the recall or lower-order cognitive level (Chin, 2006), while open-ended questions help students construct conceptual knowledge and engage them in higher order thinking (Baird and Northfield, 1992). Comments obtained via stimulated recall revealed that the teachers persisted in asking substantial amounts of closed questions as they felt that it was important for students to know factual information, typically articulated by one of the teachers as "*It's important for students to know the facts so that they could answer exam questions*". This suggests that most of the questions posed by the teachers in the elicitation act reflect the immediate needs of students in answering examination questions. However, regurgitation of factual information might not result in students' understanding, but instead merely displays textbook knowledge (Habsah Hussin, 2006).

The second most frequent act was the follow-up act, with 1 232 counts, representing 17.34 per cent of total acts. As this act typically succeeds an elicitation act, it is not surprising that it would also fall under the high percentile. category. Data from the table show that short simple utterances dominated the follow-up act, manifested through the follow-up brief accept, follow-up repetition, and follow-up reject sub-acts amounting to 885 (398 + 364 + 123) counts. In comparison, follow-up acts, comprising follow-up reformulation and follow-up elaboration which had more content substance only occurred 275 (169 + 106) times. The low incidence of the latter group of follow-up sub-acts may be related to the low incidence of open-ended questions. This is because open-ended questions require higher order thinking skills which would necessitate the teachers providing a more substantial response in the follow-up act. Hence, the low incidence of open-ended questions would naturally be reflected by the low occurrences of the follow-up reformulation and follow-up elaboration sub-acts.

The next act in the high percentile category was the informative act, with a total frequency of 1 069 counts representing 15.05 of total percentage of acts. As can be seen, the bulk of the informative act is formed by the informative content sub-act which functions to transmit content related information.

The final act under the high percentile was the check act, with 1 019 counts representing 14.34 per cent of total percentage of acts. The data reveals that the checks were predominantly of the check confirmation sub-acts which seek confirmation or agreement of a preceding message. This is mainly achieved through the use of a rising questioning intonation of the word '*Ok?*' and '*right?*', which points towards an interactive oral discourse style. Teachers were also found to employ the check comprehension sub-act which indicated that effort was made to check students' understanding as the lesson progresses.

The next category is the medium percentile category. Nine acts comprising the directive, starter, reply, comment, nomination, marker, accept, conclusion, and overt repair acts fall under this category. Seven of the acts are identical to the ones identified by Sinclair and Coulthard (1975). However, two of the acts, namely, the reply and overt repair acts, are somewhat different as data generated by this study resulted in the emergence of three reply sub-acts involving reply brief, reply elaboration, and reply reject. The teachers' use of reply brief, amounting to 166 counts was slightly more than their use of reply elaboration, which amounted to 126 counts. This suggests that students asked approximately an equal number of low cognitive level questions which would merit a reply brief sub-act, and a higher cognitive level question which would necessitate a reply elaboration sub-act. The overt repair sub-act does not appear in Sinclair and Coulthard's (1975) list of acts, suggesting that this act might be particular to the context of the study. There are two sub-acts under the overt repair act, comprising the overt self repair and overt other repair sub-acts. Scrutiny of the 69 overt self repair sub-acts occurring in the data revealed that in all instances, the overt self repairs involved teachers correcting content related errors, typically illustrated in the following example:

Example 1:

T: *How to get the constant? The constant is: /sin/ r over: sin i*
eh; sorry- ← *Overt self repair*
sin i over sin r.

(P-MM-SH-Lesson 1)

Comments obtained from the stimulated recall sessions indicated that all the NNS-STTs were aware of employing the overt self repair sub-act. A single reason was cited for the use of this sub-act, namely, the importance of providing students with correct factual information. Obviously, overt self repairs are to do with correcting mistakes pertaining to content, rather than language. This implies that the occurrence of this sub-act is not related to the teachers' L2 linguistic competence, but rather, related to their status of teacher trainees lacking in both confidence and teaching experience.

Only four overt other repair sub-acts occurred in the data. A scrutiny of the four available data indicates that overt other repair sub-acts tend to occur in language related issues as can be seen in these four examples obtained from the data:

Example 2a:

T: *Done?*
S: *Dah.*
T: ***Not dah.*** ← *Overt other repair*
Done(.20)

(P-MM-SH-Lesson 1)

Example 2b:

T: *So, there are no; (.) ion—there are no ions. So, after this::?(.3)*
Ss: *Potong lah/You cut-cut.*
T: ***No.*** ← *Overt other repair*
Ss: *Can:cel! Can:cel.Cancel, cancel.*

(C-MF-DZ-Lesson 1)

Example 2c:

S: *Ha ah lah. Sorry, my fall actually.*
T: *My fault.*
Not fall. ← *Overt other repair*

(C-MF-DZ-Lesson 1)

Example 2d:

T: *So, just the two of you? [T referring to the only two boys present]*
S: *Of me lah Teacher.*
T: ***No.*** ← *Overt other repair*
Of you::

(C-MF-DZ-Lesson 2)

As could be discerned from the examples, three of the four were generated by the same NNS-STT, namely C-MF-DZ. This suggests that the overt other repair sub-act might be idiosyncratic, thus, making it rather impossible to arrive at any conclusions. Comments obtained from the two STTs who employed the overt other repair act revealed that they overtly corrected students' language errors only when they were absolutely sure of the correct language syntax. The paucity of overt other repair sub-acts hints at the teachers' lack of confidence in correcting students' L2, which could most probably be due to

STTs' own modest L2 language proficiency level. In addition, it may also be due to the teachers' use of other subtle, less explicit ways of correcting students' errors.

The final category is the low percentile category. Four acts comprising the loop, aside, clue, and assist acts fall under this category. The occurrence of these four acts may be considered to be negligible considering that each respective act occurred less than one per cent of the total percentage of acts. Loop, aside, and clue acts are identical to the ones identified by Sinclair and Coulthard. Assist, on the other hand, is a newly identified act, generated by the collected data. However, with only three assist acts occurring in the data, it would be rather impossible to arrive at any conclusions. Nevertheless, due to its novelty, the three assist acts found in the data are shown below.

Example 3a:

T:	***Ok. How about acid?***	
S:	*Acid for cooking. Cuka. (Vinegar) Eh apa?(What's it called?)*	
T:	***Vinegar.*** ←	*Assist*
S	*Ha. Vinegar.*	

(C-MM-HL-Lesson 1)

Example 3b:

	[T holds up 4th test tube]	
T:	*Er: Faizah.*	
S:	*Brown pre-pre::*	
T:	***Precipitate***. ←	*Assist*
S:	*Brown precipitate formed.*	

(C-MF-DZ-Lesson 2)

Example 3c:

S:	*You said just now, if we want to:: calculate the pressure of the gas:*	
T:	*Yes?*	
S:	*We don't have to:: add(.2) at..at. tak tahu nak sebut (I do not know how to pronounce it)*	
T:	***Add the atmospheric pressure.*** ←	*Assist*
S:	*Ha. Atmospheric pressure. Why?*	

(P-MM-AB-Lesson 1)

As could be discerned from the three examples, teachers provided assistance in response to students' explicit request as in example 3a or implicit request as in examples 3b and 3c. It was evident that the request for assistance in all three examples was language related. It is interesting to note that in all three assist acts, the assistance provided resulted in students' uptake. However, this finding is inconclusive due to the limited amount of data. This act has not been identified by Sinclair and Coulthard most probably due to the fact that their study involved native speaker teachers and students. Being native speakers, it is highly unlikely for students to request for any language assistance, thus, the non-existence of the assist act.

Acts Perceived by Studentsa Influencing Understanding

Comments made by students via the group interview sessions revealed the recurrence of four acts being frequently cited as influencing their understanding of the content subject matter. The four acts involve the: i) elicitation act, ii) follow-up act, iii) check act, and iv) conclusion act.

Elicitation Act

Students indicated a high degree of awareness between content-related and classroom management-related questions, with the former being perceived as influencing their understanding of the content subject matter. However, when asked, students were not able to discern between open-ended and closed questions, nor were they able to differentiate between the different elicitation sub-acts of elicitation direct, elicitation prompt, elicitation repeat, elicitation probe, and elicitation clue. Rather, they tend to view all types of content related questions as a single entity. Basically, students perceived content elicitation acts as enhancing their understanding, facilitating their recall of factual information, and promoting their thinking as is evident from the student narratives in Table 2.

Table 2 Students' perceptions on the role of content-related questions

Role	Typical Student Narrative
○ To enhance understanding	- *"It helps in my* ***understanding****"*
○ To facilitate recall of factual information	- "*Membantu. Sebab menolong saya ingat facts"(Helpful as it helps me* ***remember factual information****)*
○ To promote thinking	- *"Dia dapat membantu pemikiran saya.(It* ***promotes thinking****")*

The role of elicitation acts in advancing students' thinking process, regardless of question types and functions is evident from the following illustration:

Example 4a:

	Ss:	*[Ss read in unison from slide] If you stand near a satay stall, where the seller is grilling the stick of satay, you will notice red hot charcoal ambers touch your arms. You feel no pain, just a slight sensation of hotness.*	
1	*T:*	***Is it true?***	*Elicitation prompt (closed question)*
2	*Ss:*	*Yes::*	
3	*T:*	***Why?*** *Wee,* ***Would you like to explain? Why?***	*Elicitation probe (open-ended question)*
4	*S:*	*Because: hot:*	
5	*T:*	*Explain to your friends. No need to explain to me.*	
6	*S:*	*Because itu heat capacity small.*	
7	*T:*	*Yes,* ***the heat capacity for what?***	*Elicitation probe (open-ended question)*
8	*S:*	*For the spark.*	
9	*T:*	*For the spark is small.* ***Why? Because of why?***	*Elicitation probe (open-ended question)*
10	*S:*	*Little molecule.*	
11	*T:*	*Little molecule, meaning: small amount: of(.) mass.*	

(P-FM-FW-Lesson 2)

From the above example, the teacher actually started off with an elicitation prompt sub-act involving a closed question in line 1. Following the students' response in line 2, the teacher could have responded through the use of the follow-up brief accept, which might have ended the discourse at that particular instance. However, instead of evaluating the students' response as such, the teacher chose to react through the use of an elicitation probe sub-act in line 3, which helps extend and clarify students' existing knowledge. The elicitation probe sub-acts were also employed in lines 7 and 9 resulting in the incremental building of students' existing knowledge, from '*small heat capacity*' in line 6, and relating it to '*little molecule*' in line 10. Use of the elicitation probe sub-act could help make explicit a student's implicit knowledge. Thus, although the teacher started with an initial closed-ended question, how they react to student responses could shape and influence the type of oral discourse occurring in the L2 science classroom.

Follow-up Act

Another act cited by students as influencing their understanding is the follow-up act, where students were able to report on the role of the respective follow-up sub-acts as illustrated in Table 3.

Table 3 Students' perceptions on the role of the follow-up sub-acts

Role	Typical Student Narrative
Follow-up brief accept: ○ to accept student responses	- *"Dah memang jawapan macam tu. Macam mana cikgu nak explain lagi" (**The answer is simple, making it impossible for the teacher to explain further**)*
Follow-up repetition: ○ to accept student responses ○ to make answer audible to the whole class	- *"Menolong. Sebab saya boleh tahu jawapan saya betul" (Helpful as I would then **know that my answer is correct**)* - *So that **everyone can hear the answer**.*
Follow-up reformulation: ○ to promote better understanding ○ to model language use	- *"Lebih baik kalau cikgu ulang guna ayat yang penuh rather than ulang key word sahaja. **Saya lebih faham** dan boleh salin apa dia cakap dan saya **bole guna ayat ni dalam exam**"* *(It's better for the teacher to reformulate the answer in full sentences rather than merely repeating the key words. I could **understand better**, and I **can write the formulated sentence to answer exam questions**)."*
Follow-up reject ○ to reject student responses	- *"Sebab jawapan tu basic. Jadi, murid kena peka" (The **answer is a basic one. So, students need to be aware of this**)*
Follow-up give: ○ to rectify any misconceptions	- *"**Helpful** as we're more **interested in the correct answer** actually"*
Follow-up elaboration: ○ to enhance students' understanding ○ to make students' implicit knowledge explicit	- *"Cikgu menambahkan lagi point-point jawapan, so **lebih faham**" (Teacher provides additional factual information which **enhances understanding**)* - *"Maybe the **person who answers can understand**. **But others cannot understand. So teacher can explain to others**"*

Students were able to rationalise the teachers' use of the various follow-up sub-acts. For instance students recognised the necessity for the brevity in the follow-up brief accept and follow-up reject sub-acts, which they attributed as resulting from the simplicity of the question posed. Students were also appreciative of teachers' use of the follow-up repetition and follow-up give sub-acts. The former is perceived as a way of indicating agreement with student responses, in addition to making the correct response audible to the whole class. The latter is perceived as an avenue for teachers to quickly correct any students' misconceptions. A point to note is the fact that students accorded the follow-up elaboration and follow-up reformulation sub-acts, with enhancing their understanding, articulated through the lexical item *'lebih faham'* (understand better).

Follow-up elaboration involves adding details to student responses achieved through explaining with reasons or providing additional information as illustrated below:

Example 4b:			Act/Sub-act
1	*T:*	*What is the charge?* ←	*Elicitation direct*
2		*The charge? [T points to AgCl in the chemical equation]* ←	*Elicitation repeat*
3	*S1:*	*Negative la.*	
4	*T:*	*No::* ←	*Follow-up reject*
5		*This one there are no ions.* ←	*Follow-up give*
6		*Why::?* ←	*Elicitation direct*
7	*S2:*	*Because precipitate.*	
8	*T:*	*Precipitate.* ←	*Follow-up repetition*
9		***This is in the solid state.***	}
10		***So, there are no ions freely move.***	*Follow-up elaboration*
11		*Lee Yeng Feng! (.2) [T calls another student]* ←	*Nomination*
12		*What is the next step.* ←	*Elicitation direct*

(C-FM-DZ-Lesson 1)

As the above example illustrates, the initial question of why silver chloride (AgCl) has no ions in lines 1, 2, 5, and 6, generated a student response of '*because precipitate'* in line 7. The teacher then acknowledged this response through the use of the follow-up repetition sub-act in line 8. This is succeeded by a follow-up elaboration sub-act in lines 9 and 10, used to explain that precipitate is in solid form, which prevents ions from moving freely. It could thus be discerned that in the follow-up elaboration sub-act the teacher had attempted to turn the individual student's response in line 7 into shared knowledge with the whole class. As neither verbal nor physical responses from students are required following a follow-up elaboration sub-act, students' understanding could be perceived to occur in a mental context.

Follow-up reformulation involves teacher rephrasing student responses as shown in the following example.

Example 4c:			
1	*T:*	*Ok, macam mana nak tahu berlakunya thermal quilibrium?(.3)* *[Ok, how do you know thermal equilibrium has occurred?] (.3)*	
2		*When the temperature is:?*	
3	*Ss:*	*Same:*	
4	*T:*	<u>*Same.*</u>	
5		***So, you wait until the temperature is same.*** ←	*Follow-up*
6	*S1:*	***Wait until temperature same.***	*reformulation*
7	*T:*	*To ambik bacaan thermometer, you must make sure the reading is*	
8		*constant. If not(.) your experiment normally tak jadi(.3)* *[To obtain the thermometer's reading, make sure that the reading is constant. Otherwise, your experiment will not work out]*	

(P-FM-FW-Lesson 1)

As can be seen, students' response to the sub-act provides evidence of some form of understanding taking place. The reformulated utterance "*So, you wait until the temperature is same*" in line 5 is followed immediately by an individual student attempting to repeat the reformulated phrase in line 6, which suggests the student's attempt at internalising the reformulated language.

Check Act

The next act cited by students as facilitating their understanding is the check act, as evident by typical comments made by students illustrated in Table 4.

Table 4 Students' perceptions on the role of the check comprehension sub-act

Role	**Typical Student Narrative**
Check comprehension: ○ to provide opportunities for students to ask questions	- *"Menolong. Sebab masa tu saya* ***boleh beritahu Cikgu saya faham ke tak****" (Helpful as I* ***could then inform the teacher whether I have understood or not****)* - *"It helps as it* ***gives students time to ask****"*

As could be discerned from the comments, the main reason why the check comprehension sub-act has been perceived to facilitate understanding is because it provides opportunities for students to indicate their understanding or non-understanding. However, analysis of this sub-act from the collected data revealed that students rarely respond to teachers' comprehension checks. In terms of quantity, of the 304 comprehension check sub-acts occurring in the data (refer to Table 1), 241 (80% of 304) did not yield any student response; 48 (15% of 304) resulted in one word student responses such as '*yes*' or '*Ok*' to indicate understanding, and '*no*' or '*repeat*' to indicate non-understanding. Only 15 counts (approximately 5% of 304) of the check comprehension sub-acts resulted in students asking for further clarification. This usually takes the form of student elicitation as shown below:

Example 4d:

1 *T: Tapi kalau, kalau untuk coolant, you ambik contoh, contoh you ambik*
[But if, if for coolant, for example, for example you take]
2 *liquid Q, two thousand and five hundred.*
3 *So, it has low specific heat capacity. It will absorb all the heat faster,*
4 *and the liquid will get high temperature in short time.*
5 *So, it's not good, because you're going to maintain ah: your engine in low*
6 *temperature.*
7 *So, you need to use the liquid with <u>high:</u> specific heat capacity.*
8 ***Ok?*** ← *Check comprehension*
9 *S:* ***Ini high volume?*** *[It has high volume?]*
10 *T: No. It's not about volume. It's about the heat capacity. Specific heat capacity.*
11 *Who cannot differentiate between heat capacity and(.) specific heat*
12 *capacity?(.2) A few Ss raised their hands]*
13

(P-FM-FW-Lesson 2)

The above example is an extract taken from a longer teacher generated input on '*heat capacity and specific heat capacity*'. In lines 1 to 7, an example was used to help clarify what '*specific heat capacity*' is, before culminating in a comprehension check achieved through the use of '*Ok?*' uttered in a rising intonation in line 8. In line 9, a student took the opportunity to clarify her thoughts by asking a question. In line 10, the teacher responded by indicating that the student's perception is incorrect. In lines 12 and 13, she checked other students' understanding. Students' indication of non-understanding resulted in the teacher further explaining the concept of '*specific heat capacity*' (which is not shown in this extract). This suggests that students seeking clarification during the occurrence of the check comprehension sub-act may trigger further explanation by the teacher, which in turn could facilitate students' understanding,

Conclusion Act

The final act cited by students as influencing their understanding is the conclusion act. Students' typical comments are displayed in Table 5.

Table 5 Students' perceptions on the role of the conclusion act

Role	Typical Student Narrative
○ To facilitate understanding	- ***"Kesimpulan penting** sebab kita boleh **recall balik apa yang kita dah belajar**." **(Conclusion is important** as **it helps us to recall what we have learnt)***

It could be discerned that the conclusion act which students perceived to influence their understanding involves teachers emphasising or highlighting the main points taught in the particular lesson either at the end of a factual information or at the end of a lesson. Such conclusions tend to be formulated via the use of explicit language involving phrases such as *"to sum up…"*, and *"in conclusion…"*. However, analysis of the data revealed that explicit language was not the only means of prefacing a conclusion act. There were other means of doing so such as through the use of the discourse marker '*so*' or signalled through the use of anaphoric references such as '*this*' or '*that*'. Thus, students' over reliance on explicit language cues to signal conclusion acts might cause them to disregard this act when less explicit language cues are used.

DISCUSSION

Altogether, seventeen acts highly resembling those identified by Sinclair and Coutlhard (1975) were generated by the participating teachers in the L2 science classroom. Nevertheless, two of the acts, namely, overt repair, and assist were newly identified acts. This suggests that some acts occurring in the classroom could be particular to specific classroom contexts. In this study, the two acts appeared, as the study's participants were inexperienced non-native speaker teachers interacting with ELLs. Thus, the occurrence of the overt self repair sub-act achieved through teachers' use of explicit language such as '*sorry*', '*eh*', and '*no*' which were all used to rectify content related errors, was most probably a reflection of the teachers' inexperience. This is because they have yet to attain the confidence of a fully-fledged science teacher. Likewise, the occurrence of the overt other repair sub-act, and assist act which involved rectifying students' L2 language production, reflect the context of the L2 science classroom with ELLs. The status of ELLs brings with it the connotation of learners still in the process of learning the L2, which inevitably leads to some difficulties in articulating their thoughts in the L2. Thus, the use of the overt other repair sub-act, and assist act is a perfectly common reflex of teachers in the process of teaching. A point to note is the paucity of the overt other repair sub-act and the assist act generated by the data. This could be construed as an indication of the teachers' discomfort or reluctance to be involved in students' interlanguage development, which suggests that a more detailed analysis of how NNS teachers react to issues pertaining to students' L2 would need to be conducted to obtain more conclusive evidence. However, what is more important is the fact that the occurrence of the overt other repair sub-act and the assist act, although somewhat limited, suggest that there might be a need for NNS science teachers to be trained in supporting students' L2 interlanguage development. Lacking such awareness and training would result in the L2 science classroom being unable to foster students' L2 development.

Another finding which emerged from the study is the prevalence of the elicitation, follow-up, and informative acts. The pervasiveness of these three acts indicates that the triadic dialogue of the initiation-response-follow-up (IRF) sequence continue to dominate the L2 science classroom discourse. Findings of these studies showed how a more meaningful classroom discussion could emerge if student responses were to be followed by further teacher questioning, particularly in the form of the elicitation probe sub-act, which functions to request for further clarification of students' previous responses. Unfortunately, only a small fraction of the elicitation probe sub-act occurred in the data, suggesting the under utilisation of this sub-act. Another act which shows a high incidence of occurrence is the check act, particularly the check confirmation and check comprehension sub-acts, which suggests teachers' attempt to make the lesson more conversational and interactive. However, few of the check acts resulted in extended verbal responses from students, resulting in teachers' continual dominance of the L2 science classroom discourse.

In terms of the perceived value of the teacher generated acts, students cited four acts, namely, the elicitation, follow-up, check, and conclusion acts, as aiding their understanding. For the elicitation act, students perceived all elicitation sub-acts as positively influencing their understanding, provided the questions are content related. However, analysis of the discourse revealed that the elicitation probe sub-act, involving the posing of another question related to a student's initial response showed the most potential in enhancing students' understanding. Like other studies (see Chin, 2006), findings of this study attest to the ability of the elicitation probe sub-act to help students build on their existing knowledge, articulate their thoughts, and thus make their implicit knowledge explicit. However, the study found a somewhat limited occurrence of the elicitation probe sub-act, suggesting that their use were under-utilised. This could lead us to assume that the participating teachers lack full awareness of the value of this sub-act in facilitating students' understanding.

For the follow-up act, students were more discerning, and were able to articulate the roles of the various follow-up sub-acts, citing the follow-up reformulation and follow-up elaboration sub-acts as influencing their understanding. Value of the follow-up reformulation act has been asserted by Cullen (2002) who argues that teacher reformulation may function as a model of correct language usage. Evidence obtained from the data concurs with this view as there was indication that in some instances, students were able to generate the same language pattern immediately or subsequently to teachers' use of the sub-act. This implies that students noticed the language input in the follow-up reformulation sub-act, and were able to assimilate the input to become intake. However, the value of the follow-up elaboration sub-act is not as clear cut because this sub-act merely requires students to listen.

Students also perceived the check act, particularly the comprehension check sub-act as playing a role in facilitating their understanding. They argue that this sub-act allows them the opportunity to ask questions. However, there was hardly any evidence to support this claim. In fact, it was found that a majority of the comprehension check sub-act were either met with silence or single word student responses. Some researchers have argued that this lack of student response to comprehension checks could be due to the one way information flow from teachers to students which does not provide much opportunity for negotiation of meaning in the classroom to occur (see Pica and Long, 1986). There might be some truth to this as it was found that students participating in an active learning environment achieved through discussion sessions displayed a higher propensity to generate questions compared to those attending traditional classes which uses a lecture format (see Marbach-Ad and Sokolove, 2000).

The final act to be cited by students as influencing their understanding is the conclusion act. However, students tend to only focus on explicit summaries signalled through the use of explicit language like 'in *summary…*' and '*to conclude…*'. Thus, summaries signalled through the use of anaphoric references comprising '*this*' or '*that*', or the connective discourse marker '*so*', have a high tendency of being ignored by students. This implies that despite appreciating the value of the conclusion act, students may not be able to recognise less explicit language used to signal the onset of the conclusion act.

Noticeably missing from the list of acts perceived by students as facilitating their understanding is the informative act. This is somewhat surprising considering this study found the main focus of talk occurring in the L2 science classroom to be on the subject matter, which inevitably would occur in the informative content sub-act. However, its absence from the students' list of acts which influence their understanding should not be construed with it being insignificant. The informative content sub-act has perhaps been relegated to a less significant value as the L2 science teaching implemented in the observed classroom tended to be characterised by imparted information which does not deviate much from information already available in the textbook. The strict adherence to textbook information would naturally demote the value of the content knowledge imparted in the informative content sub-act in the classroom.

Limitations and Implications

The findings of this study have made inroads into our understanding of the acts employed by NNS teachers in the L2 science classroom which may help facilitate students' understanding. Nevertheless, the results of this study should be interpreted with the following limitations in mind. First, due to the small number of participants, some of the acts could be idiosyncratic to particular teachers rather than the norm of the group. Thus, the inclusion of more NNS teachers would enable the results to be generalised. Second, the involvement of only sixty-one ELLs in the group interview sessions may not generate a comprehensive set of findings. Perhaps a better picture could be obtained through the employment of another research instrument able to accommodate a larger number of students.

Findings of this study show the prevalence of teacher dominance despite the rhetoric of the science curriculum policies' emphasis on inquiry and problem solving skills, as well as critical and creative thinking skills, which advocates students' active involvement (Ministry of Education Malaysia 2013). This clearly non-symmetrical role continues to put the reins of how students acquire scientific knowledge, and the language employed in the acquisition of that knowledge, to be firmly in the hands of teachers, which puts the urgency in the appropriate L2 training of NNS science teachers. Pertinent findings of this study which should be given due attention in such training programmes include i) the paucity of overt repair and assist acts, ii) the pervasiveness of the elicitation, follow-up, informative and check acts, iii) the underutilisation of the elicitation probe and follow-up reformulation sub-acts, and iv) students' perceptions on the positive influence of the elicitation, follow-up, conclusion, and check acts on their understanding.

Findings of this study may be used to offer a more realistic approach in implementing L2 science teaching and learning in the context such as the Malaysian one, where both teachers and students are not proficient in the L2. The alignment of acts generated by NNS teachers in the L2 science classroom with ELLs' perceptions of the value of these acts would inevitably result in a more effective construction of shared knowledge.

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