

# Examining Asian Mathematics Classrooms Through the Lens of the Distribution of Responsibility for Knowledge Generation

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# The Learner's Perspective Study

'An International Research Collaboration in Mathematics Education.'



# The LPS community

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# Methodological Entailments

If classroom practice is co-constructed, then it becomes essential to document the intentions, actions and inferences of all classroom participants.

A classroom takes on a different aspect according to how you are positioned within it or in relation to it.



# Studying Lesson Sequences by Competent Teachers

- Competence defined by local criteria
- 8th grade mathematics classes in demographically different urban schools
- Lesson sequences covering one 'topic' for each teacher (after a familiarisation period of up to one week)
- Three video cameras plus on-site mixing to provide interview stimulus
- Post-lesson video-stimulated interviews with students and teacher
- Written materials photocopied and scanned in
- Student test(s) and Teacher questionnaires

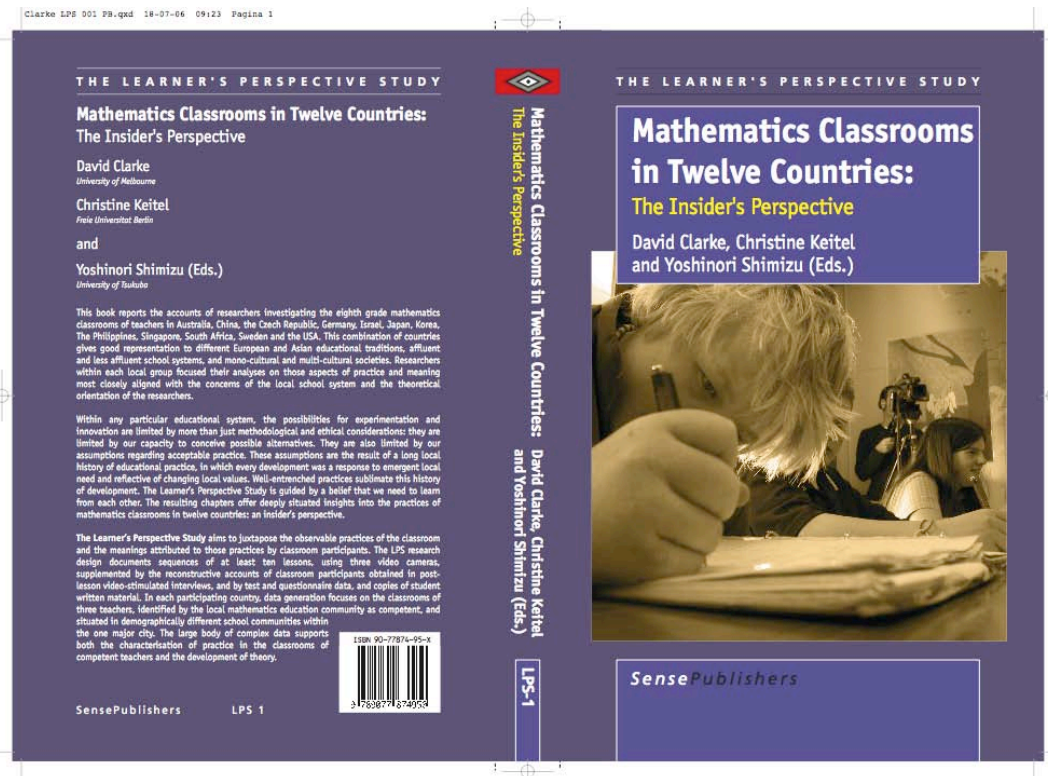
# Data Generation



# Research and Local Curricular Priorities

In LPS Book One, the research group in each country reported analyses on those aspects of their local practice that were of greatest local interest.

For example: the Singapore team chose to focus on textbook use and homework.



# Identifying A Possible Unit of Comparative Analysis

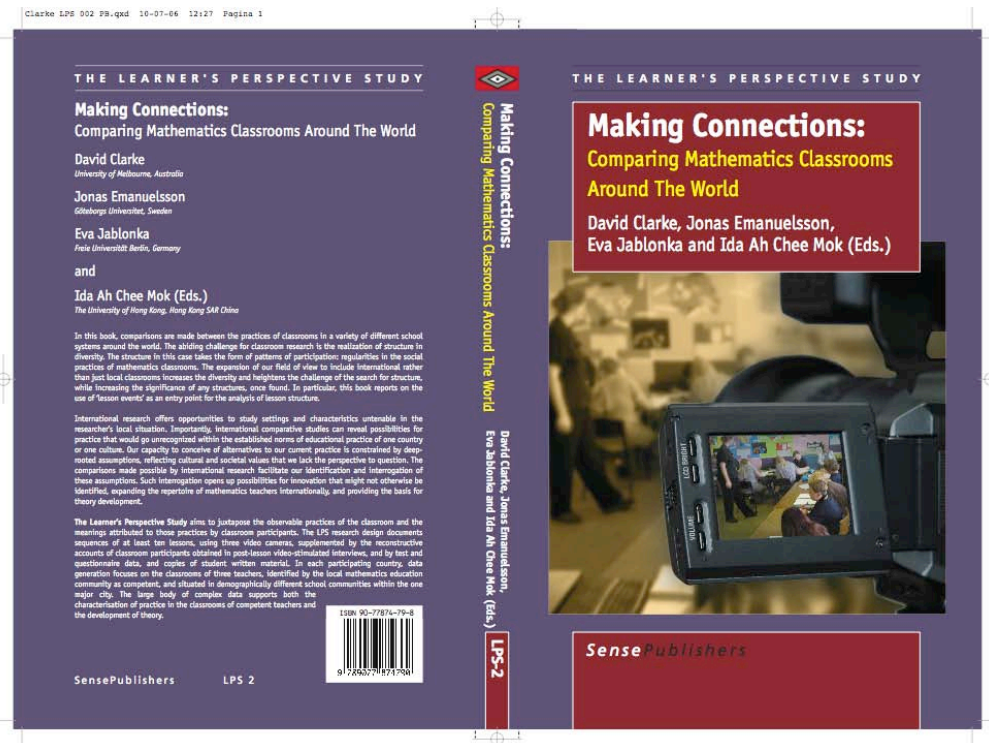
Our analyses should be focused on that level of activity that is in closest correspondence to the level at which teachers are obliged to make structural instructional decisions.

What might be the constituent instructional components from which teachers construct their classroom practice?

LPS Book Two concentrated on comparative analyses (Clarke, Emanuelsson, Jablonka, & Mok, 2006). The challenge addressed in book two was to identify a suitable unit of comparative analysis.

One such unit was the 'lesson event' and several chapters in LPS Book Two focused on particular lesson events such as:

- Kikan-Shido  
(Between Desks Instruction)
- Learning Tasks
- Beginning the Lesson
- Matome (Summing Up)



# The Distribution of Responsibility for Knowledge Generation

- Our analyses of mathematics classroom practice in several countries suggest that **the responsibility for knowledge generation is purposefully distributed in the classrooms of competent teachers,** within the institutional and cultural norms constraining that practice.

# Studying Classroom Discourse

- Research involving classroom interactions has tended to focus on either the teacher's talk or teacher-students' interactions in either whole class or group discussion.
- Very few studies have examined the role of student-student private interactions in generating knowledge in the classroom.
- Clarke and Seah (2004) analysed both public interactions and interpersonal interactions and passage of key mathematical terms across the interface between these two discourse settings.

# Analysing the Distribution of Responsibility for Knowledge Generation

Mathematical Idea/Term	0 – 1 mins	1 - 2 mins	2 - 3 mins	3 - 4 mins	4 - 5 mins	5 - 6 mins
Current Activity	(0:00 to 2:57) T reviewed the things learnt in the previous lesson with the class; drawing x- & y-axes (coordinate axes), locating the coords. of a pt & features of 2 pts having the same abscissa.			(2:57 to 8:19) T discussed the method to find the coords. of a pts and marked the 5 points on the blackboard: (1)find the quadrant where the point belongs; (2)draw a line perpendicular to x-axis & a line perpendicular to y-axis; (3)locate & note coords. of point.		
Coordinate(s)	T (17:15)	T (06:26) Eve (07:15) T (09:15) T (50:01)	T (07:13) T (03:19)			T (27:19)
Area						
Abscissa		Anthea (30:14) T (32:05)		T (03:19) T (34:11)		T (27:19)
x-axis	Sam (43:17) Eve (52:26) T (56:03)	T (32:05)		T (34:11)	T (08:15)	Anthea (29:15)P
Ordinate		Simon (48:17) T (50:01)		T (24:13)	T (08:15)	T (27:19)
y-axis	Sam (43:17) T (52:09) Eve (52:26)	T (09:15)			T (49:29)	Eve (30:12)P
Transient Terms	Eve (51:04): Coordinate axis.	T (50:01): ... rectangular coordinate plane.	Anthea (18:22)P: rectangular plane			Eve (30:12)P location

# ‘Generative Chains’

- Our aim was (and is) to construct ‘generative chains’ of initiated and revoiced mathematical ideas (terms, concepts, procedures), annotating each point in the chain with respect to speaker, audience, reception, any referents, and the authority claimed or accorded by or to the speaker.

# 'Studiocode' - Video Analysis Software

Studiocode 2.0.5 File Edit Windows Rows Capture Analysis Output Help

00:02:56.27 00:38:59.60 450 Fps

A1-LO4T subfuncDavnointeraction

merge rows append slow best tracks Find Database Matrix Note

00:15:35.71

1. A1-LO4 T  
 2. Kikan-shido  
 3. Monitoring student activity  
 4. Guiding student activity  
 5. Organisational  
 6. Murakashi social talk  
 7. Selecting work  
 8. Monitoring progress  
 9. Questioning student  
 10. Monitoring completion of work  
 11. Encouraging student  
 12. Instruction/advice desk  
 13. Guiding through questioning  
 14. Re-directing students  
 15. Answering a question  
 16. Giving advice at board  
 17. Guiding whole class  
 18. Handout materials  
 19. Collect materials  
 20. Arranging room  
 21. School related  
 22. Non-school related

What I want is the perimeter of this shape. So what does that, what does that mean? What am I asking you to find?

LessonTranscript - Imported

	1	2	3	4
	Column 1	Column 2	Column 3	Column 4
21	00:05:38:10 00:00:00:07	Levi	When you know the radius.	
22	00:05:38:17 00:00:02:11	T	O.K.	
23	00:05:40:28 00:00:05:78	T	[to all] Let's have a look at this question. What am I asking you to find here? I haven't told you yet, have I?	
24	00:05:46:06 00:00:07:02	T	What I want is the perimeter of this shape. So what does that, what does that mean? What am I asking you to find?	
25	00:05:51:08 00:00:01:18	T	[to Amit] Amit.	
26	00:05:54:26 00:00:00:91	Amit	The distance.	
27	00:05:55:17 00:00:03:95	T	Go on. The distance...	

Code input table FINAL CHAPTER

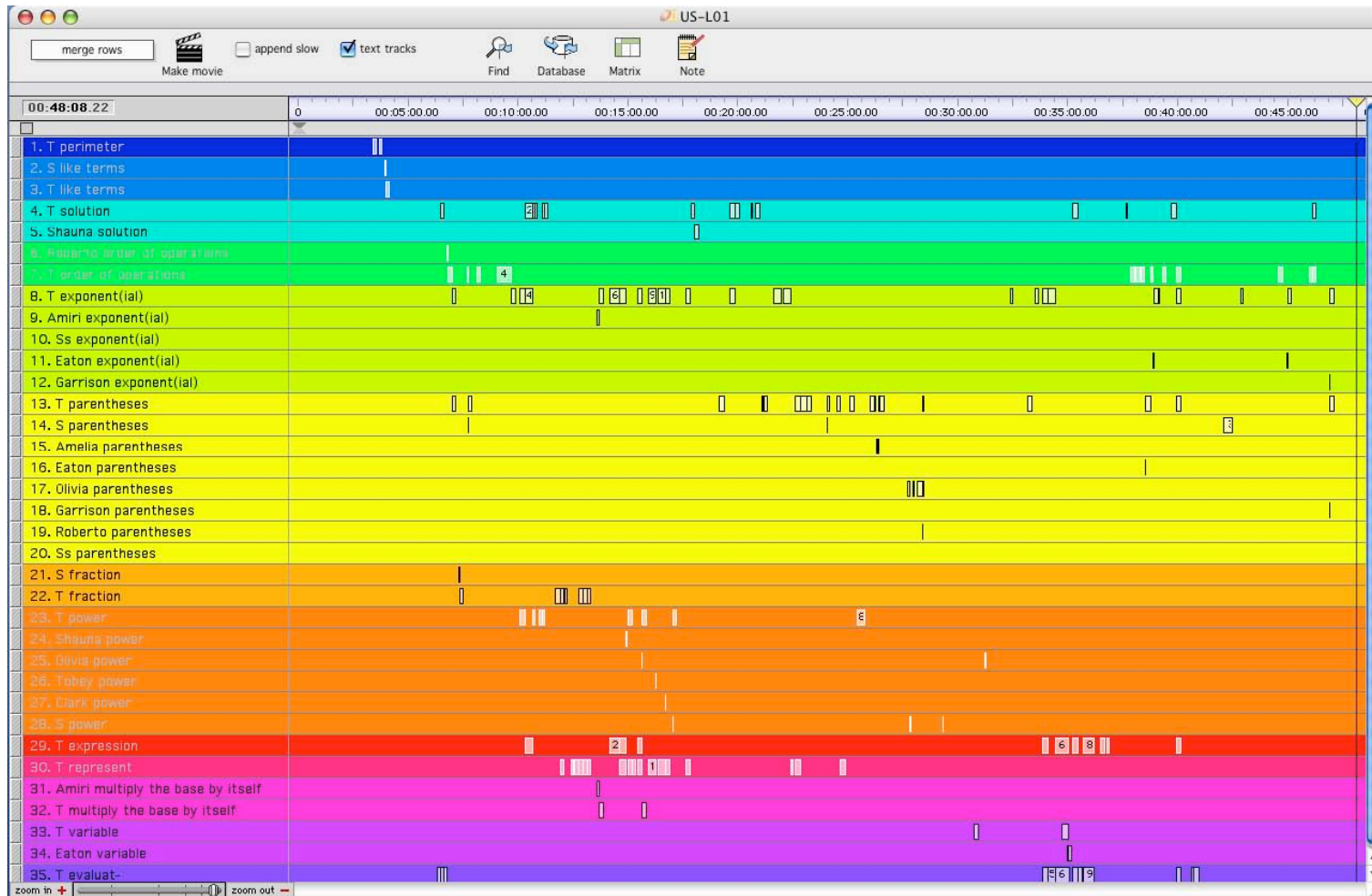
Capture Code Edit Matrix Enter (TAB) Clear (ESC) Reset Button Keys Links

Default lead 2

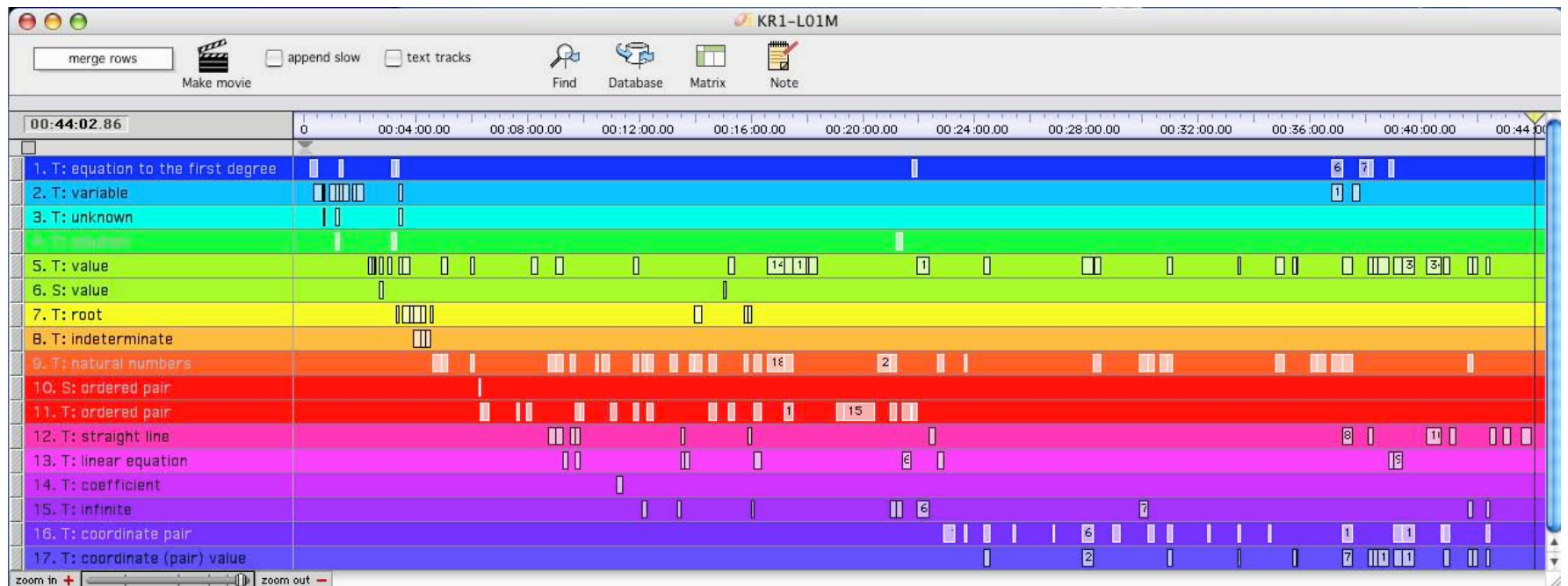
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graph TD
    Kikan-Shido --> Monitoring[Monitoring student activity]
    Kikan-Shido --> Guiding[Guiding student activity]
    Kikan-Shido --> Organisational[Organisational]
    Kikan-Shido --> Social[Social talk]
    Monitoring --> Selecting[Selecting work]
    Monitoring --> Progress[Monitoring progress]
    Monitoring --> Questioning[Questioning student]
    Monitoring --> Completion[Monitoring completion of work]
    Guiding --> Encouraging[Encouraging student]
    Guiding --> Advice[Giving instruction/advice desk]
    Guiding --> Questioning2[Guiding through questioning]
    Guiding --> Redirecting[Re-directing students]
    Organisational --> Handout[Handout materials]
    Organisational --> Collect[Collect materials]
    Organisational --> Arranging[Arranging room]
    Social --> School[School related]
    Social --> NonSchool[Non-School Related]
    
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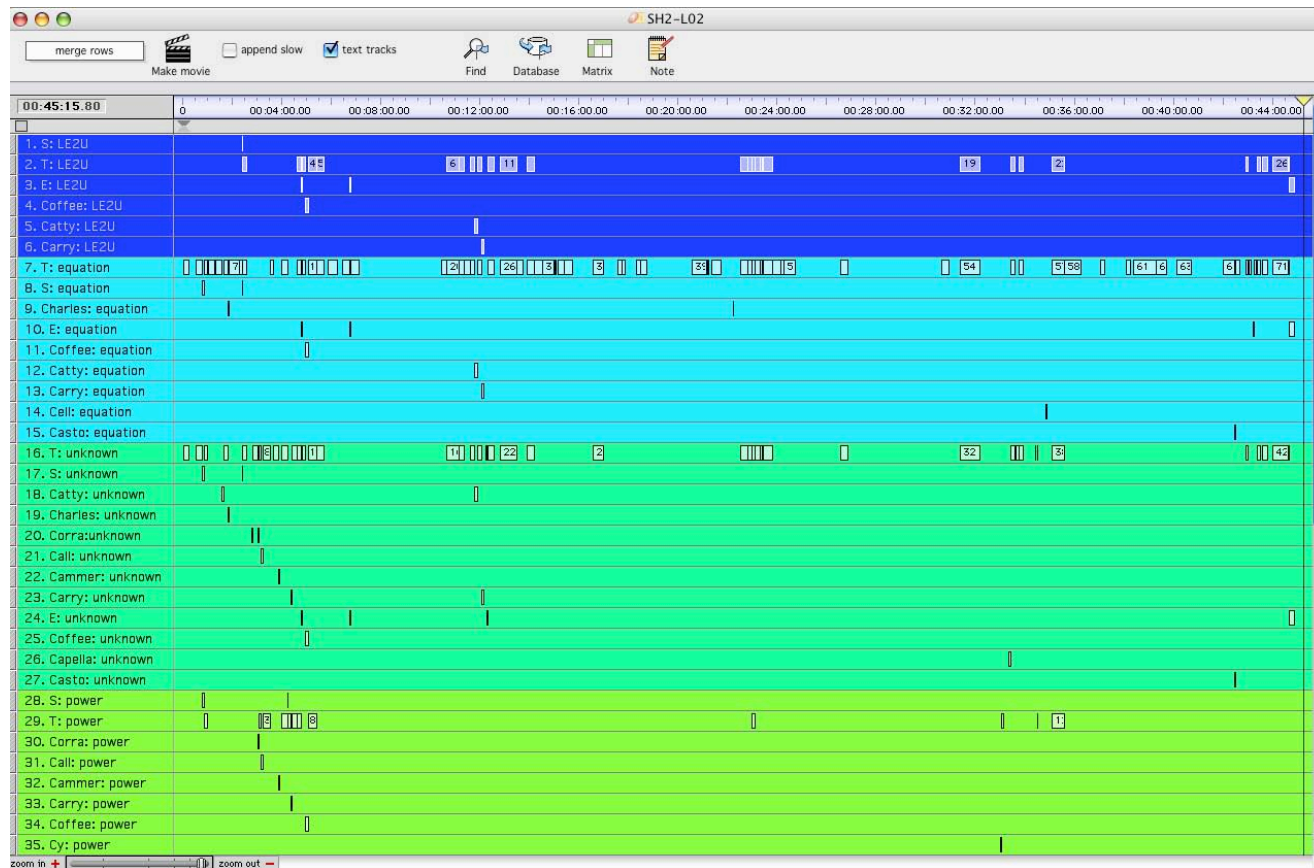
# Tracing the Flow of Ideas: US1-L01



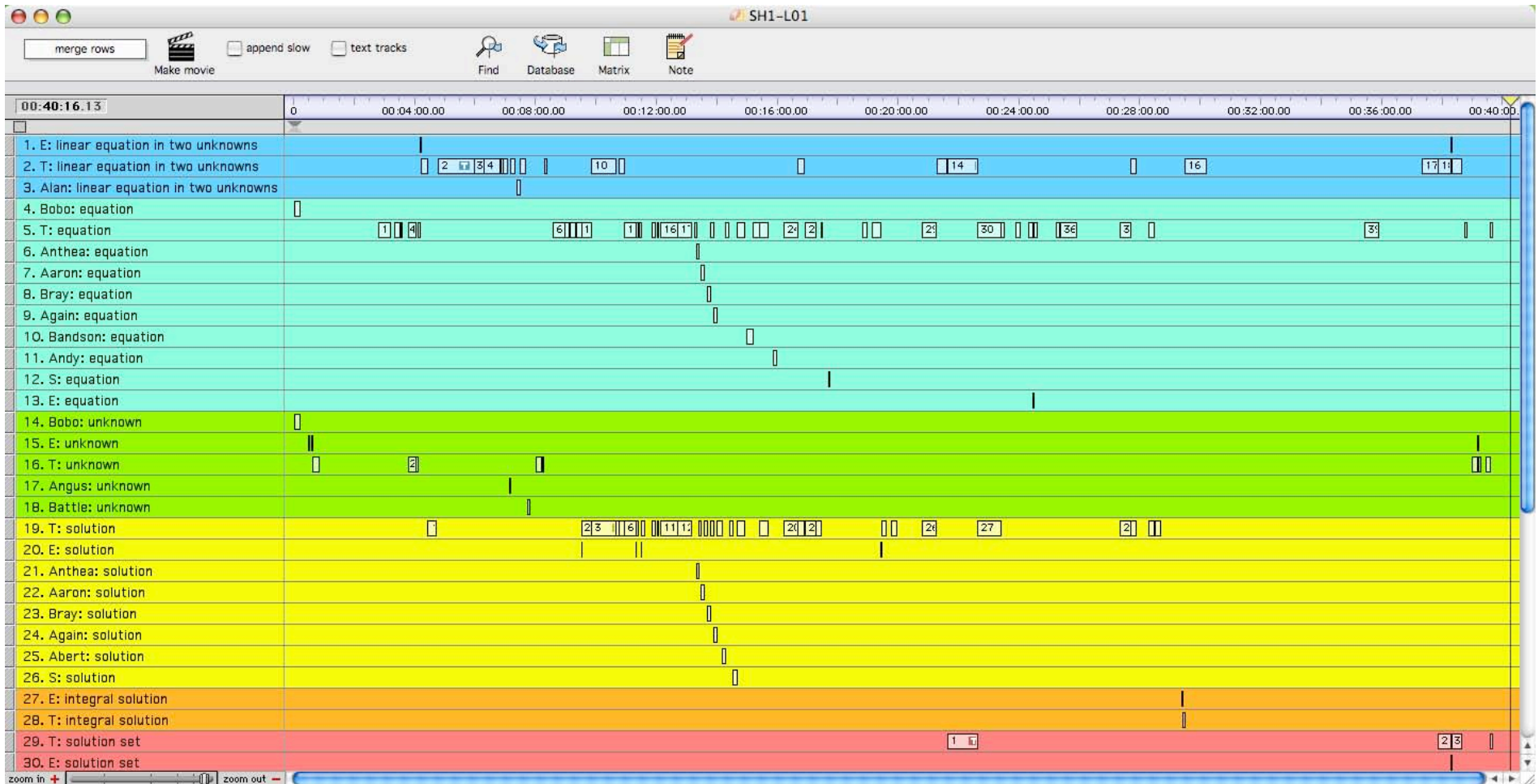
# Tracing the Flow of Ideas: KR1-L01



# Tracing the Flow of Ideas: SH2-L02



# Tracing the Flow of Ideas: SH1-L01



# Examining patterns of language use

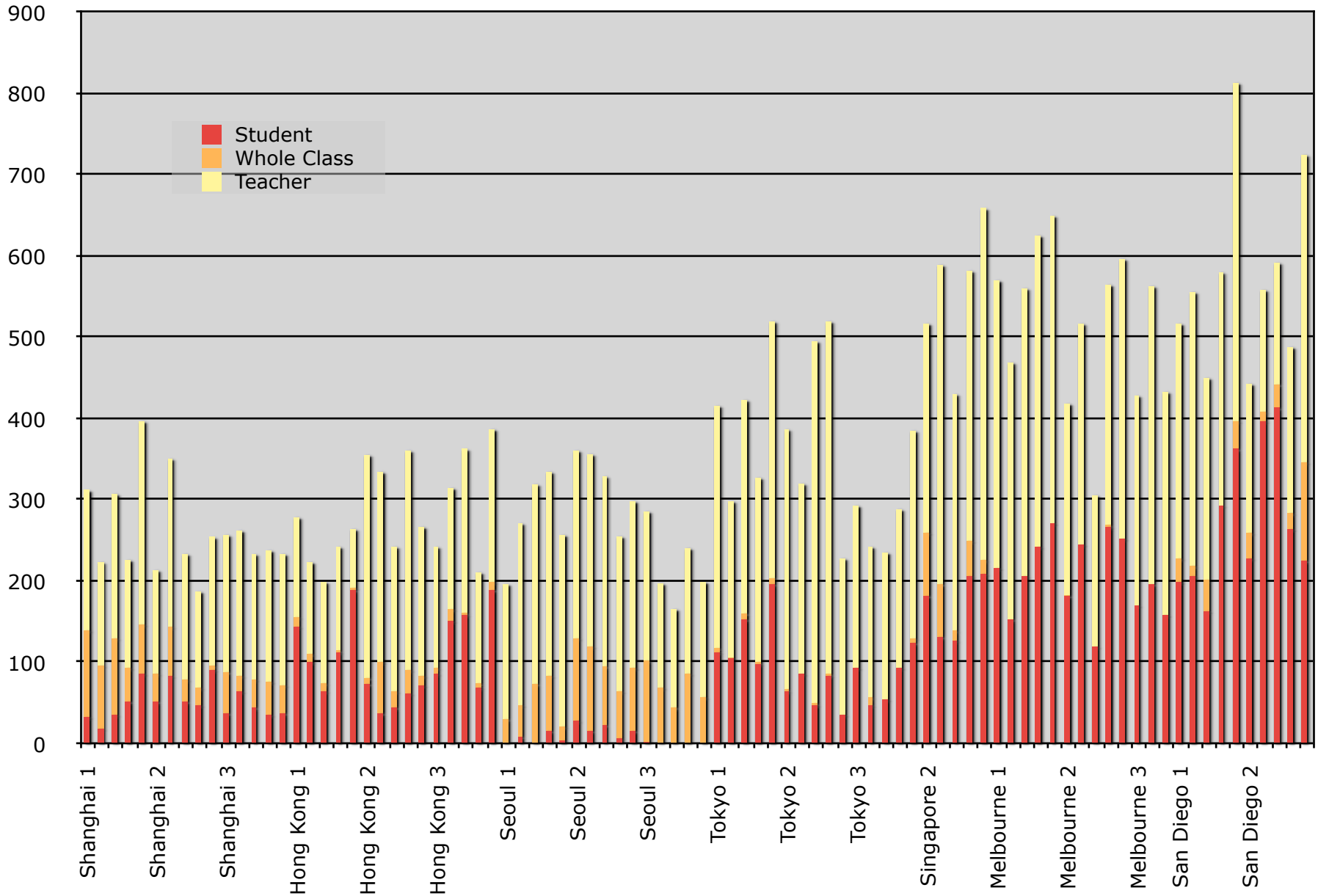
The highly visual nature of the timeline display can reveal temporal patterns in the coded terms. In the case of Shanghai Teacher One, the solicited articulation of the key term (e.g. “solution”) by a sequence of students, seems to be a distinctive characteristic of that teacher’s practice. Once identified, such distinctive patterns can be examined in more detail. Consider specifically the transcript of a two-minute interaction (min: sec) focusing on the term “solution.”

12:42 (m:s)	T:	So let's read ... ah, let's read question one, question one. It says... in the following pairs of number value, each of them can be matched with a pair of x and y. So, let's read this. It is asking, which of them are the <b>solutions</b> of the equation two x plus y equals three? Which are the <b>solutions</b> of the equation three x plus four y equals two? Come on, have a try.
13:10	T:	So, let's take a look. How about the first one? Oh, ok, you.
13:14	Anthea:	x is equal to zero, y is equal to three. It is.
13:17	T:	It's an equation. That means, x is equal to zero, y is equal to three. It is... ?
13:21	Anthea:	It is a <b>solution</b> of the equation two x plus y equals three..
13:24	T:	A <b>solution</b> . Okay, sit down please. How about you, Aaron?
13:28	Aaron:	x equals zero and y equals one over two is a <b>solution</b> of the equation three x plus four y equals two..

# Examining patterns of language use

13:35	T:	Ah, a <b>solution</b> of this. Sit down please. Let's continue. Question three, question three. Come on, (...) [APOLLO and AMANDA raising their hands]
13:41	Bray:	If $x$ equals negative two, $y$ equals two, it is the <b>solution</b> of the equation three $x$ plus two $y$ equals two.
13:48	T:	Oh,..... it's a <b>solution</b> of the equation three $x$ plus four $y$ equals two. A solution, right? Ok, sit down please. Let's continue. Come on.
13:55	Again:	When $x$ equals one over two, $y$ equals two, it is the <b>solution</b> of the equation two $x$ plus $y$ equals three.
14:00	T:	Okay, it is a <b>solution</b> of two $x$ plus $y$ equals three. Okay, sit down please. So now, $x$ equals one, $y$ equals one over two, come on, (...) Tell me.
14:12	Abert:	When $x$ equals one, $y$ equals negative one over two, it is a <b>solution</b> of three $x$ plus four $y$ equals two.
14:17	T:	Okay, he says when $x$ equals one, $y$ equals negative one over two, and the equation is three $x$ plus four $y$ equals-
14:23	T:	Oh, he says-
14:24	E:	No it isn't.
14:26	T:	It's a <b>solution</b> of two $x$ plus $y$ equals three. And so, okay, (...) Tell me.
14:33	S:	When $x$ equals one, $y$ equals negative one over two, it is neither the <b>solution</b> of two $x$ plus $y$ equals three nor the solution of three $x$ plus four $y$ equals two.
14:41	T:	Right. So he says they are neither the <b>solution</b> of the equation two $x$ plus $y$ equals three nor the equation three $x$ plus four $y$ equals two. So why? Why aren't they?

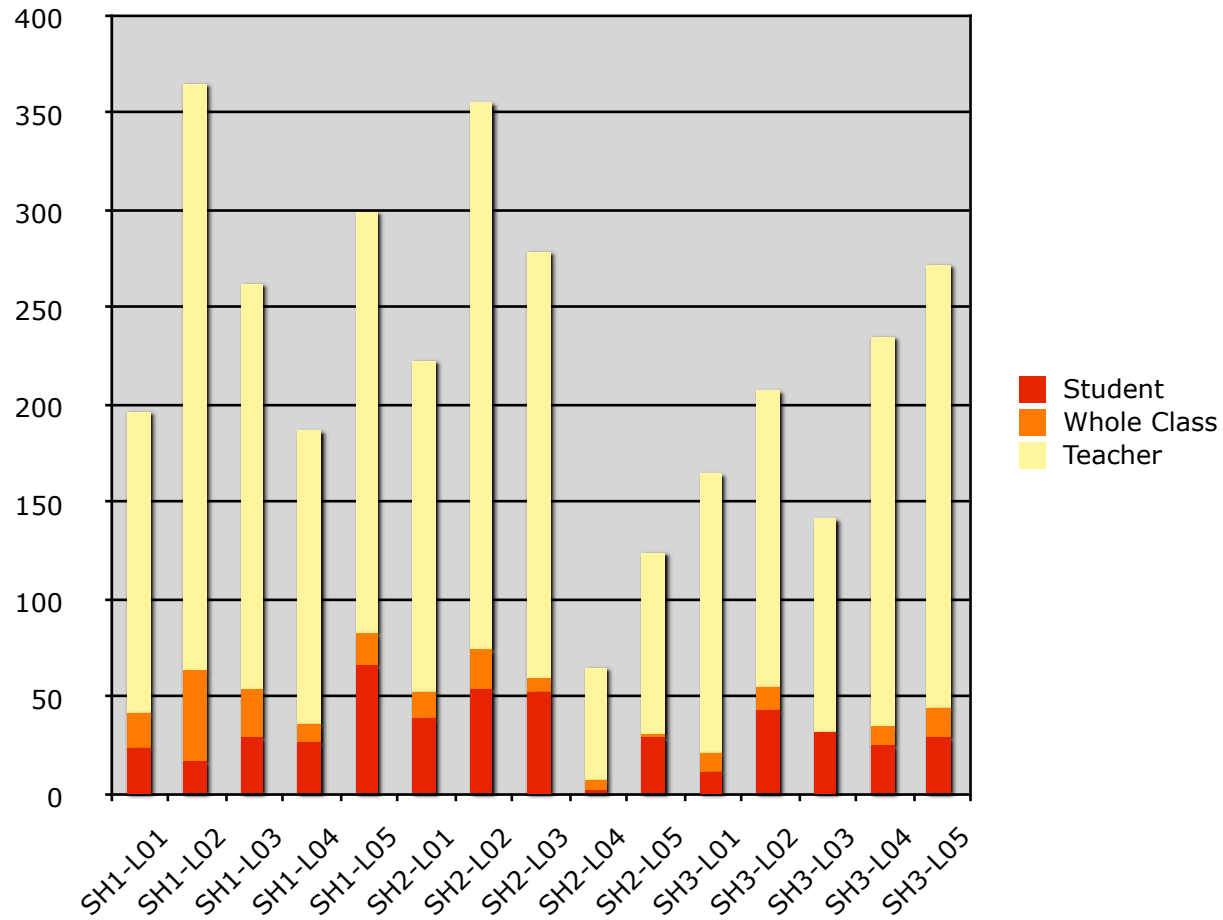
# Public Oral Interactivity: Frequency of Utterances



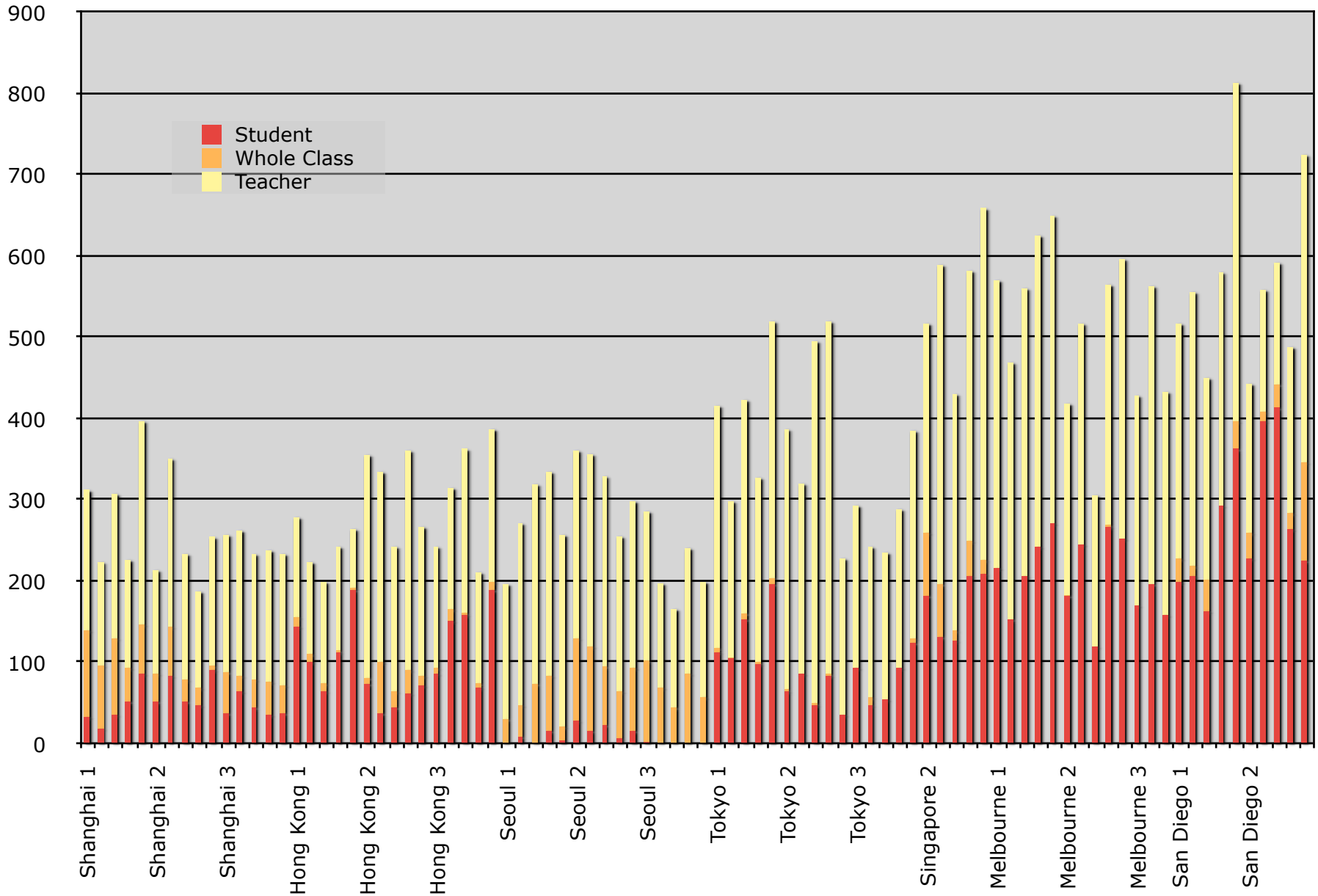
# Operationalising mathematical orality

- By 'mathematical orality' we mean the frequency of spoken mathematical terms by either teacher or students in whole class discussion or teacher-student interactions.
- This included choral recitation of mathematical terms by the class, both choral response to a teacher question and the reading aloud of text presented on the board or in the textbook.
- In the terminology used by Clarke and Seah (2005), this analysis focused on primary and secondary terms.

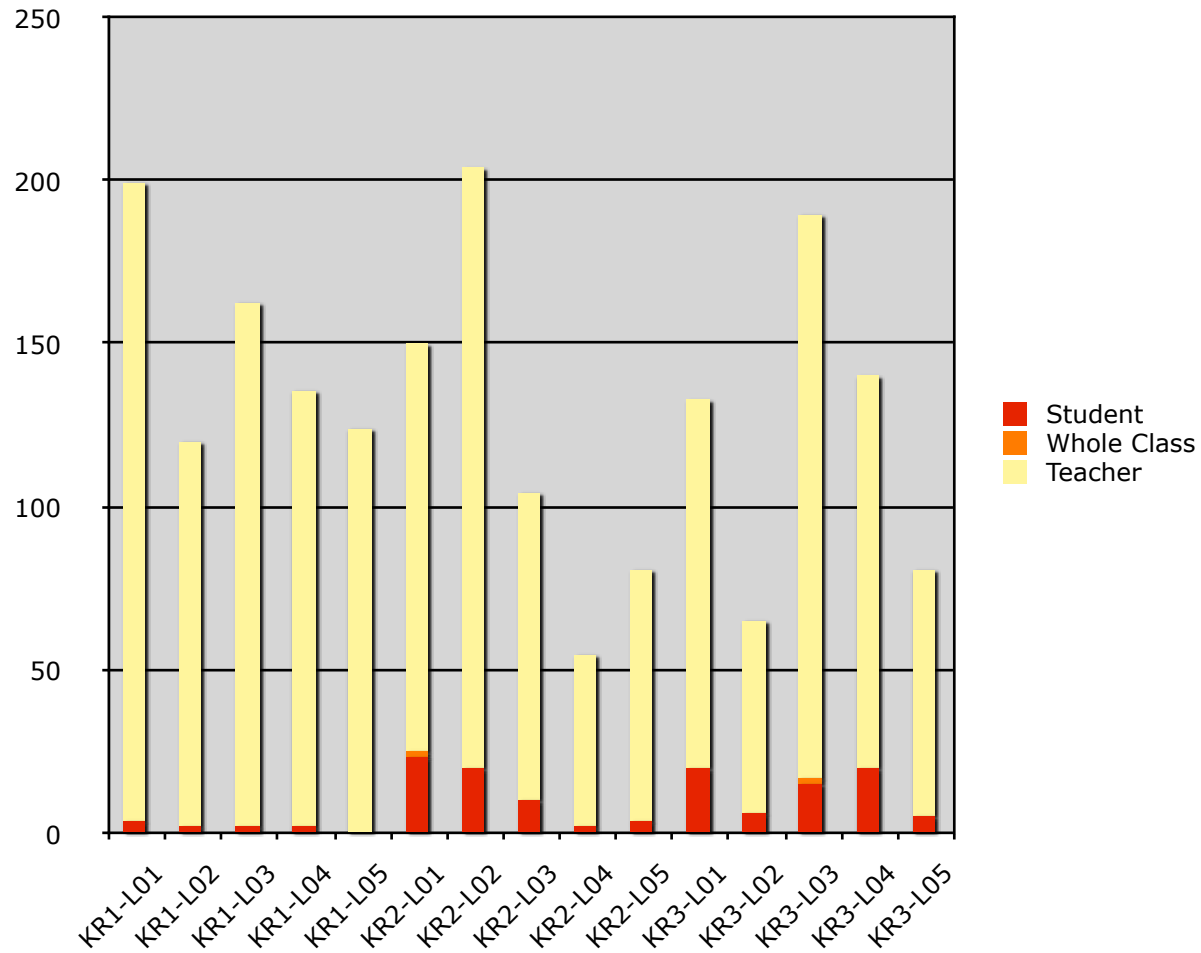
# Frequency of Use of Key Mathematical Terms - Shanghai



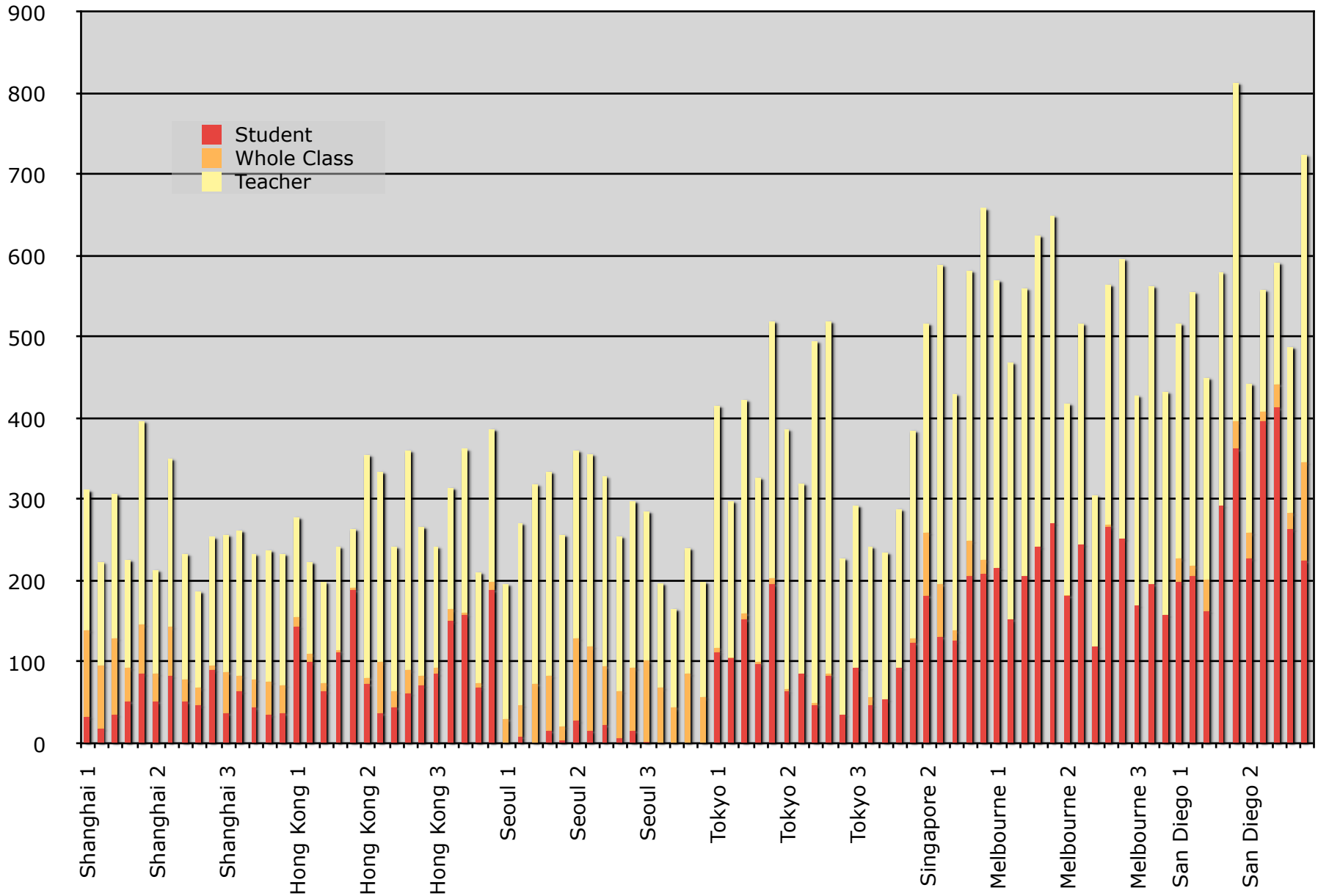
# Public Oral Interactivity: Frequency of Utterances



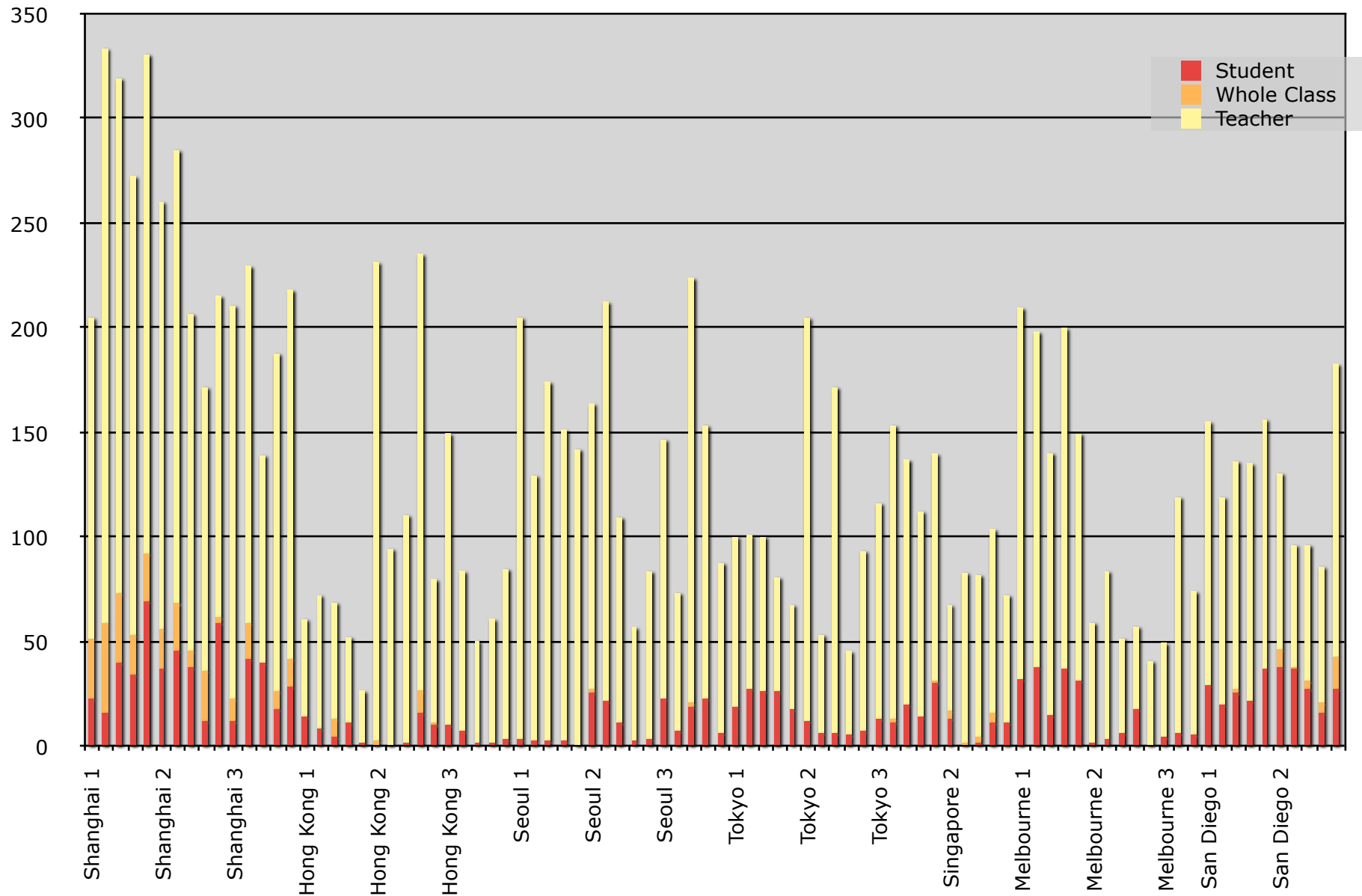
# Frequency of Use of Key Mathematical Terms - Korea



# Public Oral Interactivity: Frequency of Utterances



# Mathematical Orality: Frequency of Use of Key Mathematical Terms



# Pedagogical principles and implicit theories of learning

- The value attached to affording student spoken mathematics in some classrooms could suggest adherence to a theory of learning that emphasizes the significance of the spoken word in facilitating the internalisation of knowledge.
- The use of choral response, while consistent with such a belief, could be no more than a management strategy.

# Problematizing “The Asian Classroom”

- Significant differences were identified between the classrooms studied, challenging simplistic characterisations of ‘the Asian classroom’ as enacting a single pedagogy, and suggesting that, irrespective of cultural similarities, local pedagogies reflect very different assumptions about learning and instruction - and, in particular, about the function of spoken technical terms in the teaching and learning of mathematics.

# Competence as a Cultural Construct

The most striking attributes of classroom practice internationally are its diversity and the extent to which each society has constructed teaching competence in a form reflective of local cultural and national aspirations.

## Mathematical Orality as a distinguishing characteristic

- The results suggest that one characteristic that might be identified with a national norm of practice could be the level of mathematical orality: relatively high orality characterising the mathematics classes in Shanghai, while lessons in Seoul and Hong Kong involved much less frequent spoken mathematical terms.

## Mathematical Orality as a distinguishing characteristic

- A critical distinguishing characteristic was the form of prompt by which the teacher elicited student spoken mathematics.
- Students in the Shanghai classrooms had the opportunity to articulate their understanding of key mathematical terms through a structured process of teacher invitation and prompt that built upon the contributions of a sequence of students.

# The Responsibility for Knowledge Generation

- If the responsibility for knowledge generation can be identified with the individual who first introduces a mathematical term into the classroom discussion in a particular lesson, then the classrooms in Japan provided many instances where a student made the first announcement of a mathematical term without specific teacher prompting. These differences are non-trivial and suggest different instructional theories underlying classroom practice.

# The Distribution of Responsibility for Knowledge Generation and Mathematical Orality

- The relative frequency and the nature of the contributions of teacher and students to this spoken mathematics provides an indication of those classrooms in which the responsibility for knowledge generation is shared between teacher and students.
- The connection of classroom mathematical orality (both public and private) to learning outcomes will constitute the next stage in our research.

# Thank You

- To express interest in researching classrooms internationally, email me at:

[d.clarke@unimelb.edu.au](mailto:d.clarke@unimelb.edu.au)

- For information about the International Centre for Classroom Research access:

<http://www.edfac.unimelb.edu.au/ict/iccr>

- For information and papers on the Learner's Perspective Study access:

<http://extranet.edfac.unimelb.edu.au/DSME/Inc>

