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MATHEMATICS EDUCATION AND APPLIED LINGUISTICS: WORKING GROUP REPORT

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INTRODUCTION

There is a long-standing interest within the mathematics education community in the language dimension of teaching and learning mathematics. The four organisers of this working group have been exploring this aspect of mathematics education from our different perspectives as mathematics educators and applied linguists (see Barwell, Leung, Morgan & Street, 2001, forthcoming). We have found that our different perspectives illuminate different aspects of mathematics classroom interaction. We are then able to explore how these different aspects inter-relate. Our collaboration leads us to feel that wider interaction between mathematics education and applied linguistics would be fruitful for both communities. Our aim in offering this working group session was therefore to create an opportunity for such an interaction to develop.

In the session offered at the Bristol meeting, we wanted to explore how the fields of applied linguistics and mathematics education might illuminate each other. What could applied linguists learn from mathematics education? What could mathematics educators learn from applied linguistics? As a way into these issues we first invited participants to work with a transcript of a mathematics classroom discussion concerning the notion of 'dimension'. An extract from the transcript is reproduced on the next two pages. Each of us proposed a question which captures something we are looking for in the transcript, and so indirectly captures something about how we are looking at the data. Our questions were:

> *Richard Barwell:* What examples of ambiguity are there in the discussion and what role does that ambiguity play in the development of the mathematics?
>
> *Constant Leung:* What pattern/s of participation can we identify in the discourse data and how might these pattern/s be related to the ideas/s of 'dimension'?
>
> *Candia Morgan:* How is 'dimension' defined by the participants and what role might a more formal definition play in the teaching and learning of this concept.
>
> *Brian Street:* How does a student get facilitated to make such statements as: "There's no such thing as a one dimensional shape coz a line is kind of like a rectangle filled in"? And what is the significance of such an utterance?

Participants worked on these questions in groups before sharing their observations in a plenary discussion.

An extract from 'Dimensions'.

This extract is from a video recording of a Year 5 numeracy session of June 2001. The class consists of 24 students from a range of ethnic backgrounds. T = the teacher. RB = Richard Barwell. Students are indicated by letters, e.g. W. Bold type indicates emphasis.

The extract is essentially the beginning of the lesson, following a few minutes settling the class down.

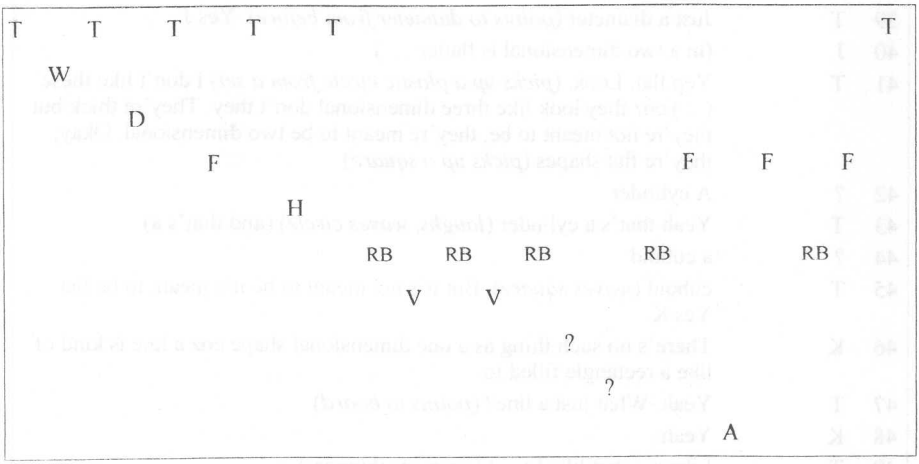
1	T	Right the learning objective for our mental and oral starter is to be able to **describe** two dimensional shapes. (*Writes on board*)
2		Can anyone remind us what a two dimensional shape is (*Lot of noise outside classroom*)
3		B can you shut the door please. W.
4	W	(…)
5	T	(you can describe it as) **flat** okay good flat's a good way for you to describe two dimensional shapes. D.
6	D	(It hasn't) got breadth, width and length.
7	T	It's got breadth and length it's got **width** and it's got length yep correct and it's got length. Anything else about two dimensional shapes got. What's the difference then between two dimensional and three dimensional. W tells us it's **flat** that's fine. Are there anything else to say. F.
8	F	Um a (three dimensional shape) has breadth, length and height.
9	T	Well done. This would be a two dimensional shape (*draws a square*) (…) and a three dimensional shape will have an extra dimension. That would be a **solid** shape (*draws a cube*) okay G.
10		Can you open the window please F and V could you open the window please.
11	H to T	(…)
12	T to RB	(do you know what) a one dimensional shape (is)?
13	RB	A one dimensional shape
14	V	I know what a one dimensional [shape is
15	RB	[go on
16	V	A line
17	RB	(…) so what's a no- a zero dimensional shape
18	?	Nothing
19	?	A dot
20	RB	Yeah. It's got no length, no width, no height
21	F	But a dot but a dot but a dot might end up as a circle
22	A	Yeah coz a little tiny circle (*gestures a circle with a finger*) (…)

23	F	(…)
24	RB	So how many dimensions has a circle got
25	F	None (*shrugs*)
26	T	(*draws circle*) None? One?
27	?	One
28		(*Many voices*)
29	G	(*Gestures a circle*)
30	T	What's this bit called (*drawing round circle again*)
31	Several	Radius
32	T	Circumference. It's got a circumference. It's got a diameter (*draws E-W diameter*) it's got a radius (*draws NE radius*). What d'you think Z?
33	Z?	Two dimensional
34	T	Two dimensional?
35	?	Yeah
36	V	And a sphere is three dimensional
37	T	And a sphere is three dimensional. What would be a one dimensional circle then
38	A	(…) a line (*shrugs*)
39	T	Just a diameter (*points to diameter from before*). Yes J
40	J	(m a two dimensional is flatter …)
41	T	Yep flat. Look. (*picks up a plastic circle from a set*) I don't like these (…) coz they look like three dimensional don't they. They're thick but they're not meant to be, they're meant to be two dimensional. Okay, they're flat shapes (*picks up a square*)
42	?	A cylinder
43	T	Yeah that's a cylinder (*laughs, waves circle*) (and that's a)
44	?	a cuboid
45	T	cuboid (*waves square*). But it's not meant to be it's meant to be flat. Yes K.
46	K	There's no such thing as a one dimensional shape coz a line is kind of like a rectangle filled in
47	T	Yeah. What just a line? (*points to board*)
48	K	Yeah
49	T	Like a- what like [(…) (*gestures thinness*)
50	K	[a rectangle filled in
51	T	(*Giggles*) Very clever. Like a dot (*draws dot*) oops (*erases, does again*) like that. It's interesting isn't it. Yes H?

Following work on the dimensions transcript and a sharing of observations from each group, discussion moved on to consider, in the light of the work on the transcript, what the two fields could potentially learn from each other. Rather than attempt to summarise the whole discussion, we report one contribution drawing on techniques from applied linguistics which stimulated particular interest from participants.

WHAT COULD MATHEMATICS EDUCATORS LEARN FROM APPLIED LINGUISTS?

Participants in the working group were particularly interested in the tools and approaches which enabled Constant Leung and Brian Street, the two representatives of applied linguistics, to make their observations and analysis. In addressing, for example, his question concerning the patterns of participation taking place in the 'dimensions' classroom, Constant Leung made use of a grid representation in which each column represents a turn of interaction, and each participant is assigned the next available row at the point at which they enter the discussion. The following small example shows the resulting representation of the first 23 turns of the transcript extract shown in this report:



Using this format, Constant Leung was able to point out a number of patterns in the interaction. Much of the transcript, for example, consists of teacher-student exchanges, as in the first 8 - 10 columns of the above diagram. In these columns, the teacher speaks on alternate turns, with different students speaking in between. Turns 1-10 broadly conform to a routine Initiation-Response-Feedback (I-R-F) sequence, with the teacher attempting partial or selective positive feedback: the teacher selectively ignores unwelcome pupil responses. In this phase the teacher has 7 turns while the pupils have 3 turns. The length of the teacher's utterances are much longer

in this phase. The tone is 'authoritative' and evaluative, so that the relationship projected is that of knower-learner. The language expressions comprise questions or requests of a pedagogic or regulative nature and declarative statements of a pedagogic nature.

Given this I-R-F pattern, Constant was interested in sequences where this pattern was disrupted, such as the central and right-hand side of the grid. In this part of the interaction, two students (V and F) take more than one turn, with students responding to both a teacher (RB) and other students (e.g. A). The interaction becomes much more contingent, involving a larger number of pupils and a larger number of turns by pupils. The teacher takes 15, mostly short turns, RB 5 turns and the pupils 25 turns. The teacher does try a didactic/informational response in turn 32 on 'circumference and diameters' but in other turns there is a much stronger sense of the teacher thinking with the pupils. The language expressions of the teacher now comprise declarative (including some negative) statements, elicitation and rhetorical questions, all of which appear to serve to continue the discussion. The language of the pupils now comprises declarative statements which are responses to the teacher but which also *extend* the range of information and ideas. In this phase of the discussion the impression is one of open engagement with the topic and its extension, rather than the closure seen in the first phase.

WHAT COULD APPLIED LINGUISTS LEARN FROM MATHEMATICS EDUCATORS?

One key observation in relation to this question is that the transcript shows a large number of pupil utterances which on a formal level are declarative statements, serving as answers to the teacher's questions (see above). Discoursally, however, they appear to have developed the discussion and ideas about the concept of dimension. The teacher's stance in treating the pupils' contributions as part of a genuine exchange has helped to achieve this. So the I-R-F sequence does not necessarily lead to a 'closed' discussion each time, as in the first phase of the sequence. In other words, the *discourse meaning* of individual utterances depends on the underlying purpose of the discussion. Form and function are not always in one-to-one correspondence. These observations may lead applied linguistics to turn to mathematics educators with further questions, including:

- How typical is this kind of complex exchange in mathematics classrooms?
- How do mathematics teachers organise different kinds of discussion and how do pupils differentiate between these very different levels of meaning when in terms of form the language sounds very similar?

CONCLUDING REMARKS AND PLANS FOR THE FUTURE

We have used this report to give a flavour of the activities of the working group session at the meeting in Bristol. We have highlighted how one means of representing interaction (the grid) coupled with a range of linguistic concepts (e.g. form vs.

function) led to interesting and productive insights for the participants in the session. Furthermore, our discussion points to some ways in which mathematics educators and applied linguists have much can benefit from working together. This was certainly the feeling of participants at the end of the session, who expressed an interest in continuing the working group at future meetings. Participants were particularly interested in hearing Constant and Brian 'talk through' approaches to analysing the transcript. We shall therefore aim to organise further opportunities of this kind. Participants also suggested that preparatory information, such as transcripts, could be disseminated before future meetings to allow efficient use of the time available.

We should be pleased to receive suggestions for activities, linguistic approaches or linguists to include in future sessions. For further information or to pass on suggestions, contact Richard Barwell, richard.barwell@bris.ac.uk.

REFERENCES

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