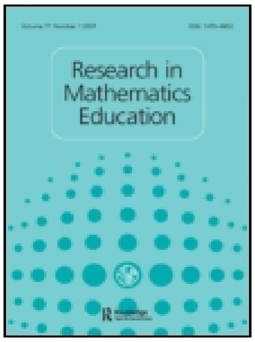

Routledge
Taylor & Francis Group

Research in Mathematics Education

ISSN: 1479-4802 (Print) 1754-0178 (Online) Journal homepage: http://www.tandfonline.com/loi/rrme20

USES OF UNISON RESPONSES IN MATHEMATICS CLASSROOMS

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ABSTRACT

In this paper I look at the roles of unison response in the teaching and learning of mathematics. The early part of the paper is based on a collection of field-data from mathematics lessons in Cape Town. A variety of purposes are identified as being used for unison responses. I examine these in relation to their mathematical meanings, to assumptions about oral traditions and to further uses of chorused response described by Tahta and others.

INTRODUCTION

In classrooms without resources such as computers and textbooks the spoken word is the dominant source of mathematical stimulus, the dominant shaper of the mathematical environment in which students construct mathematical meanings. In this paper I am not concerned with the epistemological nature of such constructions; rather I look on utterances as raw material for construction, the teachers' utterances being seen as those of an expert, and the creation of student responses as acts of mental reorganisation in order to produce the required utterance. Here I take school mathematics to be an interconnected set of conventional structures with which students are to become familiar through constructing meanings which are affirmed, or otherwise, by the teacher. Familiarity is manifested in students' ability to choose to do appropriate mathematical things, and to do them correctly. The choice of such a top-level 'down home' approach to learning mathematics for this paper is deliberate and not naïve. It allows further analysis from semantic, psychological, educational and socio-cultural perspectives, while generating questions about interactional routines which are appropriate for preservice and inservice teachers.

I researched the phenomenon of unison responses in classrooms to find out more about their use. I approached this both as a researcher and a mathematics educator. The motivation was that of an educator in that I had become aware that unison response was a major teaching strategy in poorly-resourced schools in underachieving countries. I found myself asking questions about its effects, not wishing to make hasty judgements based on superficial impressions. I needed to collect information about this, systematically, in order to make sense of what I was seeing. The research question was phenomenographic:

> What unison response routines are used in mathematics classrooms? What differences can be discerned and described?

Although classrooms all over the world use unison responses in the learning of mathematics, even if it is only at the level of calling out obvious answers, or reciting multiplication tables, I thought that the very high level of use in under-resourced classrooms in South Africa would provide a suitable field for the kind of research which intends to develop descriptions and further research questions, rather than theories and answers. I therefore used opportunities afforded to me through my work as an educator to explore interactional routines.

THE RESEARCH

I observed nineteen secondary mathematics lessons, containing between 40 and 50 students each, taught by thirteen teachers in four urban schools. Classes ranged from year 8 to year 12. Compulsory mathematics ceases at the end of year 9 but anyone who wants to go to college must continue until year 12. Two of the schools (K and P) are in townships of immense social deprivation, are under-resourced and have some poorly qualified staff. Students in these schools generally come from uneducated families and are unlikely to have had continuous education. One of the schools (G) has a more stable recent history, with pupils from a wide range of social backgrounds and well-qualified teachers. All of these are township schools. The other school (W) was formerly mono-culturally European and well-resourced; I only observed two classes in school W. None of the schools are multi-racial although G and W could claim to be so in a nominal sense.

The sample was completely opportunistic, being schools to which I had been invited for a variety of reasons such as supporting teachers or fieldworkers. In addition, the willingness of teachers to have me in their classrooms suggests that I was observing confident practitioners who may have been showing me their best practice. In the classrooms I was seen as an interested visitor from abroad. This made systematic observation and enquiry difficult but as far as was possible I took verbatim notes of oral routines which included unison response. Most lessons started with such routines followed by written individual work. Thus I was taking notes of nearly everything which happened at the start of lessons and was able to go back and complete these notes at the start of the written work. I felt it was important to have as complete a record as possible, even though I was aiming to produce a collection of different types. Even if I felt I was hearing something similar to what I had heard before I nevertheless recorded it so that I could do a fine-grained analysis looking for small differences which might be significant.

Sometimes complete note-taking was not possible because teaching was in Xhosa or Afrikaans (I only speak English) or because I could not hear well due to the echoing structure of the school buildings. This echo would have made tape-recording very hard.

While pupils were working on exercises I would wander around, observe as much written work as I could and ask them about it. Typically, I would ask "how did you do this?" or "what did you say to yourself while you did this?". Sometimes I would engage in more direct questioning in order to find out the precise nature of their difficulty. Sometimes I talked with the teacher after class, but my status, and institutional organisational problems, made this unproductive in research terms. Consequently I have little evidence of pedagogic intention. However, the data I collected can be regarded as systematically generated in the field.

In the rest of this paper I shall develop descriptions and questions about unison responses, illustrated by examples from the data, as a contribution to the literature on classroom interaction. Interactional routines are seen as scaffolds in a particular way. Since speech is the main method of communication of mathematics in such classrooms (apart from text on the board, if there is one) the teacher's speech provides a major model of mathematical thought, particularly as (s)he is seen as the expert. The structures of interactional routines are therefore guides to mathematical thought. The over-riding question for me, as a mathematics educator, is:

> Given a particular pedagogic routine, what is it possible to learn about mathematics?

Before I consider this question, it is useful to think about how rote-learning might contribute to knowledge.

ORAL TRADITIONS

I have heard people speak of "the oral tradition" of culture and epistemology as a justification for heavy use of oral routines in schools in developing countries. In K and P all students have African backgrounds, there are few textbooks and teachers do rely heavily on oral teaching. However, just because they rely on chorused oral response it does not necessarily mean that the teaching is culturally-based. It is a fallacy to equate rote-learning with oral tradition. It may also be patronisingly romantic to imagine that oral tradition plays any part in school-pupils' culture, particularly in view of the urbanisation and globalisation of the last century which have dislocated millions world-wide from their traditional cultures. Students' self concept in school does not necessarily connect to old traditions (Kok, 1984; Coetzee, 1998; Akande, 1999).

There is no universal traditional African culture or epistemology, but there are views of knowledge and learning which are relatively pan-African and illuminate the notion of oracy. For example, many African epistemological beliefs are based around the notion of knowledge as accumulated experience, sometimes validated by elders or forebears (Coetzee and Roux, 1998). Learning, therefore, is experience.

The accumulated knowledge of a group of people might be communicated through stories, proverbs, puzzles and songs, and repetition of these is a mark of an educated person. According to Reagan (1995) the role of these is to stimulate intellectual and social development. Proverbs and riddles are used to develop reasoning power; stories about behaviour contain information about cultural norms and expectations and provide help to resolve dilemmas; word games 'strengthen' memory; rhymes encourage counting and the use of number words. There are also arithmetic puzzles which challenge the hearer's logic and stimulate discussion (one Veluchazi puzzle involves 11 steps to solution).

"A purely oral tradition knows no division being recollecting and doing" (Illich and Saunders, 1988). Oral tradition does not necessarily require memory for exact words and phrases; the act of retelling is not usually a feat of super-memory but of reconstructing old stories, and contributing to new stories, perspectives and knowledge (Parry, e.g. 1971). Memorised phrases provide the raw material for thought and discussion; they are not the final products of the learning process but are indicators of knowledge. And if oral tradition still is high-status cultural inheritance for some students, such as for Muslim students, it is about making meaning with (and using the advice interpreted from) learnt phrases, not about memorising them as an end in itself.

To some extent literacy ousts the need for memory, but recitation of the artefacts of high culture is still taken as a ritual sign of knowledge. It would be impressive to recite Beowulf in the original, whether one understands it all or not. Similarly, one could recite the familiar formulation of Pythagoras' theorem and yet be unable to use it to find unknown lengths, or to relate it to a diagram showing squares on the sides of a right-angled triangle (Broadley 2001).

Reghi *et al.* (1991) compared the effects of rote-learning among Asian students and learning for understanding among Australian students, testing both groups for their understanding of a text. Their results revealed that a combination of rote-learning and thoughtful repetition, used by the Asian students in their study, leads to deeper understanding of a text than reading for understanding alone. It seems that several rehearsals of the text, each with a different focus on the content, helps develop deep, structural knowledge rather than just mechanistic recall (Marton and Booth, 1997). What is puzzling here is why rote-learning should be done at all by literate students. Apparently it resolves a perceived need to acquire surface knowledge which can then be used easily in tests, and worked on in future to develop deeper knowledge.

Repetition, therefore, is required if rote-learning is to lead to deep learning. But repetition, particularly in unison, is also a way to learn by rote. Recall of the songs and playground chants of childhood is easy, and their acquisition was often effortlessly achieved by listening to and joining in with others. Repetition, particularly when there is no access to books, is therefore an important cultural requirement for learning, both for acquisition of the words and for returning to them again and again to develop deeper understanding.

TWO EXAMPLES OF CHORUSED RESPONSES

Here are two contrasting examples of chorused response. Both took place in school K with different teachers. In the first, the teacher is showing pupils how to multiply two binomial expressions in brackets to make a trinomial. As the teacher writes the terms of the product she recites phrases loudly and slowly, leaving pauses where the pupils insert words in unison.

Teacher: the first multiplied by the first gives the

Pupils: first term

Teacher: and the first multiplied by the second gives the

Some pupils: second term

Teacher: and the second multiplied by the first gives the

Some pupils: third term

Teacher: and the last by the last gives you the

Pupils: last term

I cannot be sure that all pupils were answering for the first and last terms, but it sounded like strong unison response. There was a noticeable difference between the loud, confident, bright sound of the first and last response and the less secure, lower tones of the middle two responses.

In the second case, the class are identifying the value of the angles in a fairly complicated geometric diagram using facts about angles and parallel lines. Before they started they were asked:

Teacher: What can you tell me about vertically opposite angles?

Pupils: Vertically opposite angles are equal.

Teacher: Again?

Pupils: Vertically opposite angles are equal.

Teacher: So vertically opposite angles are…?

Pupils: Equal.

A few other facts were similarly recited and most of the class were joining in, or at least were making appropriately word-like sounds.

These two examples show different uses of chorusing. In the first, the pupils are being encouraged to remember an algebraic routine, but they only have to fill out small gaps in what the teacher says. In fact, the gaps are so small that there are not many possibilities for what might fill them, given the context. There is a certain rhythm to the words (first, first and first; last, last and last) which breaks down in the middle. Filling the gap might be more to do with rhythm and participation than active, intelligent, informed choice. In the second example, pupils are having to do much more than fill a gap; they have to recite a fact which they are about to use, and have to link it to some technical words relating to angles. But of course some of them might only have the vaguest idea about what they are saying, the word 'vertically' being particularly problematic in this context.

In each class I was able to see the work pupils did on their exercises after these interactions. For many pupils in the algebra class the order in which terms were multiplied was not a problem: they knew what they needed to do but not necessarily how to do it. I had an impression that even many of those who did not join in the second part of the chorus knew which pairs of terms to multiply. Reasons for getting the wrong answer were more likely to be errors in multiplying or attempts to combine unlike terms in the product. Perhaps the learnt phrases which instructed them about these subprocedures were not being brought into play; they had not been reminded of these other necessary routines before they did the exercise.

In the geometry class most students were unable to apply the learnt geometrical facts to the diagrams. There were several reasons for this. Two of the difficulties were expected, springing from a poor understanding of the concept of angle and the difficulty in recognising angles which were not in a familiar orientation. The third, and main, reason was a widespread inability to use the learnt fact. They were nearly all able to say "vertically opposite angles are equal" but were not able to use this statement to deduce equality of, and hence ascribe values to, angles in the diagram. The statement did not tell them what to do; it was not an instruction. It functioned like a proverb or story, which needed to be interpreted and applied.

A CLASSIFICATION OF CHORUSED RESPONSES OBSERVED IN CLASSROOMS

These two events enabled me to discriminate between types of chorusing by considering the mathematical nature of the statement being chorused, the linguistic structure of the chorusing routine, and the subsequent use of it. In research terms, analysis of these events provided me with the analytical tools I could use to identify and describe differences in routines. After detailed analysis of the field notes using structure, use, assumed purpose and outcome as a framework I found several different uses and features which I shall now illustrate from the data.

Recall: Teachers use unison routines to generate, and, through repetition, to remind students of mathematical facts. For example, the teacher says:

> a square must have four equal

and pupils complete the sentence by saying

> sides

In another version the teacher says something like:

> a square must have

and pupils say

> four equal sides

In the first case the sentence must end with a noun, so choice is limited and most pupils said "sides". In the second case response was much less united and several pupils were silent as they were not being prompted to recite a well-known phrase; instead, to complete the phrase, they had to think about what they knew about squares and choose a likely answer. There are several possibilities; possibly some students were silent because they did not know which possible answer would be deemed correct. More likely, in an oral classroom, they were waiting for clues or cues about what to say. The second response requires some knowledge and risk, the first requires a limited level of classroom norms and linguistic cadence.

Instructions: Teachers use unison response to instil, through repetition, rules about how to do mathematics. For example, a teacher says:

> what we do to one side we do to the

and the pupils finish the phrase by saying:

> other

In this case the whole phrase has not been said by the pupils, they have merely finished a linguistic structure with an obvious response.

In another example, the teacher said:

> what do we do with two minuses?

and pupils answer

> two minuses make a plus

This is intended to provide an inner monologue to tell pupils what to do, but it is well-known that such a monologue is often applied in inappropriate circumstances, such as "-2 - 3 = +5".

A more worrying example of this is:

> We take out the

and the pupils respond

> common factor

The teacher models an instructional monologue she hopes pupils will use on their own. As with the one above, it can be used inappropriately. The recalled routine "we take out the common factor" was chorused when factorising and when simplifying algebraic fractions. Consequently pupils assumed it was always followed by "cancelling", omitting the common factor whatever the circumstances.

Reasoning: Teachers often use unison response to engage pupils with a sequence of mathematical reasoning. The example given above involving vertically opposite angles is one of these. Another is:

Teacher says:	If it isn't positive it must be
and pupils respond:	Negative

The teacher models how she hopes pupils will think, but this line of reasoning is oversimplistic; it ignores zero. Chorused phrases often have a symmetry which is interrupted by special cases! This reasoning routine also depends on the pupil knowing that she should consider signs and hence bring the routine into play. As with instructional routines, learners need to know when to use them. Also, in this case, the pupils have only supplied the missing opposite and may not connect this gap-filling activity with mathematical meaning at all.

A more complex example was demonstrated in school W. The class was working on a problem involving angles in circle. On the board was a toolkit of diagrams illustrating angles in the same segment (called "the butterfly"), a cyclic quadrilateral, and the alternate segment theorem. The teacher points to the diagram given with the problem and says:

Does this look like a butterfly?	Pupils say: No
Does this have any external angles?	Pupils say: No
So it must be about cyclic quadrilateral	Pupils say: Yes

Again the teacher is offering a model for reasoning, a way to go about answering examination questions. There is no guarantee that pupils are making the active choices which the teacher intends, just responding "No" when it seems sensible to do so, as in ritual speech (Pimm, p.73): pupils recognise a linguistic shape and give a well-known response

Commentary: Sometimes teachers ask pupils to join in a commentary as they work through an example on the board. In one case, the teacher did not invite participation until she got to "seven from four..." to which pupils responded “you can't”. This was a minor aspect of the whole piece of work, and it is well-known that this response can lead pupils to put zeroes down as differences in vertical subtraction algorithms. I saw no examples of pupils being invited to join in the commentaries on more central, conceptual, aspects of a worked example.

Participation: Some of the examples given above require so little from pupils in terms of mathematical engagement that I began to wonder if the main function is social participation. I cannot even say that pupils are participating in a shared mathematical discourse, because their contribution is small and dominated by gap-filling. Seen as social participation, rather than mathematical learning, the following examples make more sense:

In finding the area of a compound shape, at the end of all the geometric reasoning the teacher says:

3 times 4 is

and pupils respond

12

Is the teacher testing arithmetic? Instead of thinking about area the pupils are asked to produce the final, relatively simple, part of the associated arithmetic.

With quite an advanced class, finding the coordinates of a point of intersection, a teacher said:

This bracket gives us the x-coordinate of one of the points and this bracket gives us the x-coordinate of the

and the pupils responded

other

The pupils are not involved in the reasoning; they merely follow familiar word rhythms to supply the end of a sentence. The difference between this and the "sides of squares" example is that they may rarely have to reproduce this bit of reasoning for themselves as it is specific to a very small subset of problems they may meet. The likelihood that when they do need it they will think to use it as a recalled routine is very small.

PURPOSE OF CHORUSING

But there is an energy in a class of pupils all calling out things in unison which convinces the teacher they are participating and which may energise the pupils. When chorusing fails to happen, such as in the second example of "a square has...", this brief community becomes disparate, pupils are faced with the fact that they do not know something, and the teacher realises that there is a difficulty to which she must give some special attention. It is as if the energy of chorusing is a rejoicing at what has been achieved in the past and disunity is a sign of what has to be tackled in future. If this is the case then chorusing could be a social ploy to invite and ensure participation, to signal social inclusion and to inform future teaching of the group. Pimm (1987) says, there is

> .. a deep-rooted belief on the part of many teachers that there is a power in someone saying things aloud, and therefore it is better for the pupils to say the central part for themselves, rather than merely hear it expressed by the teacher (p.54).

There could be several reasons for this belief. First, a superficial understanding of the role of recitation in learning, separating it from its place within oral traditions and detaching it from meaning, and failing to make use of the learnt words for critical examination, discussion and revisiting in different contexts. Second, a sense that hearing one's own voice saying something makes it more likely to be retained, thus emphasising retention of verbal sounds as a way to accrue factual and procedural knowledge. Third, identification of chorus responses as feedback giving evidence of learning, such as when teachers get students to repeat a response several times until they are satisfied most students have said it correctly. Fourth, a belief that learned responses may provide scaffolding for students to develop appropriate inner monologues which are versions of the speech patterns offered by experts. Brodie (1989) points out that this process may be especially prevalent where students are, as in these four schools, learning mathematics in a second language.

What is unclear from the above examples is whether the teaching style offers any scaffolding for meaningful internalisation, or for the transformation of knowledge which allows the learner to work on a higher mental level. If it is always the teacher who initiates the routine, the learners are likely to remain teacher-dependent about the act of responding, the very act which the teacher intends to help them function alone. In addition, it was noticeable that few of the routines I observed involved the learning and use of mathematical vocabulary – a purpose of unison response which makes obvious sense when learning in a second or third language. Several, however, offered the chance to learn an algorithm or rule so that memory might take the place of a textbook. But belief that understanding enables phrase completion need not imply that phrase completion enables understanding; knowing by rote being a component of oral learning does not imply that oral learning, in the traditional sense, follows from learning by rote.

There may be a further foundation for this faith in speech. I catch myself wanting to complete the sentences of others, sometimes wanting the argument to move on more rapidly, sometimes to show that I think I know what they are articulating. There is evidence that some students do this in class, under their breath (Houssart, 2000). In each case it is a genuine expression of engagement with, and understanding of, what is being said. It can also be a way of showing how much they want to be active participants in class.

UNIVERSALITY

Is there anything specifically South African about these classroom interactions? One obvious feature is that nearly all the pupils I saw were doing mathematics in their second language, English, their first being Xhosa or Afrikaans. Sometimes their first language would be used to elaborate meaning during exposition by the teacher or while doing exercises amongst themselves, but not in the chorusing episodes (Adler, 1998; Setati, 1998). Brodie (1989) has shown that this creates obstacles on at least three levels: decoding the problem, formulating concepts and transforming concepts into mathematical symbolism. What she identifies are, in fact, well-known difficulties in solving 'word problems' even for those learning in their first language. As many writers point out, most notably Cooper and Dunne (1998) with their analysis of social class effects in this area, decoding what is expected mathematically from a given problem is influenced by a wide range of factors, experience, situation, confidence as well as linguistic features. But Brodie is not just talking about word problems, she is also sensitive to the need to 'play' with concepts in a language of choice in order to explore their meaning. Anyone taught in a formal way, where colloquial language may not be used to supplement formal explanations, is going to be deprived of informal routes to understanding.

The interactional routines were familiar to me from schools in many countries, so the language issue can be seen as additional rather than overarching. Most of the episodes appear to be using empty recall of phrases and the energy of social participation to mask a lack of cognitive stimulation and the loss of opportunities to encourage structuring of experience. This applies everywhere. By investigating situations which have familiarities and unfamiliarities, a researcher's attention can be drawn to features which, though often present, might not have been noticed before. In Cape Town classrooms, the role of language in mathematics teaching is a dominant issue, hence the dislocation of words from mathematical meaning was easier for me to see than in a UK classroom. But the dislocation, once noticed, is certainly familiar and recognising it has enabled me to analyse differences in a way which may be helpful outside South Africa.

POSITIVE USES OF CHORUSING

I do not mean to deny all uses of chorusing. There are some very powerful arguments for routinising mathematics, such as that of Mary Boole when writing of examinations

> theorists in education sometimes imagine that a good teacher should not allow the work of his class to become mechanical at all ... Education involves not only teaching, but also training. Training implies that work shall become mechanical; teaching involves preventing mechanicalness from reaching a degree fatal to progress. We must therefore allow much of the actual work to be done in a mechanical manner, without direct consciousness of its meaning; an intelligent teacher will occasionally rouse his pupils to full consciousness of what they are doing;... (1972, p.15)

Examples of such practice are given in Brown (1995) and Jennings and Dunne (1997). In Brown's example, rhythmic chorusing is used to show how the brain can work almost in a trance-like mode on repetitious calculations. When a disruption occurs (such as in counting downwards in threes past a hundred) or an added level of difficulty (such as shifting from rhythmically completing number bonds to ten to completing number bonds to a hundred in the same rhythm) the conscious brain is free to make very rapid adjustments since it is not preoccupied with effortful thought about routine matters. Indeed it strives to catch up with the original rhythm, while the maintenance of the rhythm by others (the teacher or the rest of the class) allows individuals to miss a beat occasionally but still return successfully to the full task. Routinising in this way involves more than replacing chanted instructions with a similar inner monologue; it implies the removal of the need for any instructions at all because the mathematics takes place out of the conscious mind. Such routinising allows students to move on to more complex activities without needing to think carefully about every stage.

Jennings and Dunne (1997) use rhythm and speech patterns to establish connections between written and spoken representations of fractions as numbers, thus encouraging students to link symbol and sound instantaneously in much the same way as one might sight-read music. Hewitt (Floyd *et al*, 1981) gets his students to recite in unison to emphasise particular aspects of the structures with which they are working. He also uses chanting to draw their attention to universality. He gets them to repeat algebraic expressions while rhythmically substituting different values. They start with small integers and progress to substituting very large numbers, very small numbers, then α, γ, π and so on. All these teachers give other experiences alongside the learnt words, or the unison chants, either simultaneously so that learners connect words with symbols, diagrams, apparatus or emotional responses, or at other times so that meaning can be made using a variety of experiences, senses and contexts.

Tahta and Pimm (2001) explore the positive effects of 'chanting' further, drawing distinctions between chorus, repetition, unison and chanting in order to explore possible roles for learners in the oral life of mathematics classrooms. I have used the words 'chorus' and 'unison' interchangeably to mean everyone saying the same thing at the same time in classrooms, not implying any more involvement or meaning to their utterances. The word 'chorus' has, however, a long dramatic history. In Greek drama it is often applied to one person who provides a commentary on the plot, in Eliot's 'Murder in the Cathedral' several people known as the chorus provide individual interpretations and predictions as well as collective commentary. Other dramatists give choruses roles in moving the plot forward, or remove them altogether from the action. All of these possibilities could be used to describe certain kinds of classroom interaction, and raise our awareness to other possibilities, but for this paper the distinction is not relevant. Their distinction between repetition and chanting is more useful, alerting me to the fact that not all unison responses are repeated.

In the examples I collected, some phrases are repeated immediately, presumably as an aid to memory. Other phrases are repeated many times in the classroom, but with time elapsing between repetitions, such as reciting multiplication tables once a day. In this way we learn liturgies, nursery rhymes, songs, cultural sayings, number facts and multiplication tables. We also learn chants which we use to do mathematics, such as "times the top by the top and the bottom by the bottom".

Other phrases are not repeated, because they are ad hoc parts of some current calculation or exposition, such as in the example: '3 times 4 equals?...... 12'. In such gap-filling routines, the intention is to take part, to stay awake, to keep up with the teacher, to reach the end of the worked example together.

Not all repetition is mindless; Tahta talks of "meaningful repetition" as the act of finding what is invariant in a changing situation by locating rhythms and repetition. He quotes Ree (p.69) saying 'no repetition without abstraction'. In other words, one can only repeat if one has some meta-sense of what has been said. Unfortunately for its use in mathematics classrooms, often what is abstracted is the rhythm rather than the mathematical meaning. It is much easier to make the right cadences for 'eight tens are eighty' 'nine tens are ninety' than to think of the meaning, and hence it is easy to be caught out when the sounds change at 'ten tens are ...'. And yet it gives a feeling of knowing, of taking part, of fulfilling expectations to be able to make the noises. Possibly, chanting allows learners to express patterns which they cannot express verbally or algebraically, but only, as yet, through the musical senses of rhythm and sound. However, the musical sense is simultaneously the most transcendental and fleeting of the arts. Its transcendent nature is caught by the kinds of exercise Brown and Hewitt use (above), and its fleetingness has to be avoided by repetition, so that the rhythms of classroom mathematical speech are remembered, without effort.

But when learnt words and unison responses are the main mode of teaching, and there is no attention given to other experiences with the subject matter, little might be achieved. Even with accompanying diagrams, chanting may not direct learners towards an understanding of a topic, nor allow them to use knowledge they already have. One South African teacher conducted a class on straight lines in which students were encouraged to chant "one-upon-two" many times while the teacher indicated on the board the vertical and horizontal edges of a right-angled triangle drawn to find the gradient. The students also had to recite the word "gradient" several times (although some were heard to say "radian"). However, at no time did the teacher say what gradient meant, nor connect "one-upon-two" to a half or to the slope of line in question (Bansilel, 2001). Without further experiences we could not expect students to calculate gradients successfully in a variety of contexts, and with questions posed in a variety of ways.

FURTHER QUESTIONS

The original research question led to identification of a range of uses of unison responses for recall of facts, recall of instructions, modelling reasoning, providing elaborative commentary and to ensure social participation.

Analysis of the many routines I recorded in schools suggested that a very limited view of mathematics would be gained by those for whom this kind of teaching was their only experience. Some mathematical language would be learnt; some techniques will be recalled, possibly at the appropriate time; some facts can be recited, but these may be detached from usefulness. There may be some routinisation of manipulations, such as multiplying brackets or calculating with fractions. For some, this storehouse of phrases might enable the construction of structural meanings for mathematics, but this may be rare. My conversations with pupils suggested most were unable to relate many of the learnt phrases to their exercises. Yet a few *do* learn mathematics.

Several questions about the learning of mathematics are raised by this investigation:

> How can students be helped to apply learnt phrases and ritual speech patterns meaningfully in their work? How can students be helped to discriminate between appropriate and inappropriate applications of learnt phrases?
>
> How much use, and what kinds, of chorus response are purposeful?
>
> How do successful students from classrooms where chorusing is a main teaching mode use this experience to achieve mathematical understanding?
>
> What ways can be found, particularly in under-resourced classrooms, to relate learnt phrases to other representations of their mathematical meanings?

The literature suggests further uses, such as the power of rhythm to enhance memory, ownership and fluency, and the access given to knowledge by oral text. Thus it does not make sense to dismiss unison response as a poor teaching strategy just because it is strongly associated with underachieving educational settings. Nor can the findings of this study be dismissed because it took place in such a setting. Instead, detailed exploration of the issue in a setting in which it is centrally important has, through the familiarities which emerge, served to raise questions about the poverty and power of such strategies which are applicable in *all* settings.

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