Hybridity of maths and peer talk: crazy maths

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In this chapter we show how students' collaboration regarding their work in class can sometimes facilitate a sociable 'community influenced' classroom mathematics talk. The social affordances of collaboration and indeed mathematics as a human, social activity have been examined by many others, although sometimes under the guise of equitable mathematics or inclusive mathematics pedagogy (Boaler, 2000, Boaler and Greeno, 2000, Nasir and Cobb, 2002, and many others) and earlier in the area of 'cooperative' classrooms. Such research has consistently pointed to the value of encouraging student-student interaction as a means to foster more positive identifications with mathematics, often for those who might be described as struggling learners (for example Boaler, ibid).

This chapter provides an example of how classroom talk is fundamentally social and how students' sociality can be harnessed in ways to engender a living, more vibrant, and even synergetic kind of mathematics talk (cf. Yackel, Cobb, & Wood, 1999). We explore an example of students' everyday classroom talk, drawn from an AS mathematics classroom in a college in a provincial British town, which draws predominantly from a local white working class community. Especially we focus on an example of how an alternative 'street-talk inflexed' term for estimated mean comes into being during an episode when two students' explore together their alternative solutions, as they search for their error.

Here we draw parallels with the field of literacy, for example, Hicks, 2002; McIntrye etc al, 2001, Moll and Gonzalez, 1994 who show how allowing 'community' discourse into legitimate classroom talk can provide for hybridity (Bakhtin, 1981). We suggest that captured within the students' renaming of the 'estimated mean' as 'a crazy 20' is a hybridization of 'peer' talk with "maths" talk.

We speculate that aspects of the classroom pedagogy allow this new vibrant mathematics talk to emerge, in contrast with classrooms where teacher talk dominates, where social talk becomes separated from the maths talk, and where peer is muted and hidden, or even oppositional. We suggest this may indicate that a blurring in the regulation/classification and framing (Bernstein, 1990) of the traditional pedagogic codes may both foster a more vibrant kind of classroom mathematics talk and more sociable ways for students to be mathematics learners. We suggest that this may create a synergy with some learners' social identity so that they may identify with mathematics. Here, identity is viewed as a 'nexus ... (of) multiple forms of membership through a process of reconciliation across boundaries of practice' (Wenger, 1998:163). This is a process of the 'reconciliation' of multi-membership, where the individual comes to an understanding of themselves across boundaries. The notion of reconciliation is helpful because it highlights the relations between different forms of multi-membership, e.g. of a learner with her peers outside school 'on the street' (outwith the purview of adult or parental restraint) and with her classmates in the classroom.

Background

The mathematics classroom we draw upon here is part of a 6th form College (a post-compulsory education college with students mainly between the ages of sixteen to nineteen) situated in a predominantly white working class in the former industrial North East of England. Almost all the students in the class live in the locality of the college, and typically come from areas that can be classed as of modest means. Some of the students live in social housing, usually with their families. The students in the mathematics class range from 16 to 18 years of age. They all have a grade C or above in the General Certificate of Secondary Education (GCSE) mathematics, with an unusually high proportion with weaker grades (C or grade B in the intermediate exam). In comparison with many colleges in the sample these entry grades are low, as in contrast, many 6th form or Further Education colleges (6fFE Colleges) insist on A or B grades taken at the higher level for students to progress to Advanced Level (pre-university entrance mathematics). This is a deliberate, more 'open' access College policy.

The featured classroom is taught by an experienced teacher whose practice is underpinned by deeply held beliefs in constructivist pedagogic principles (Wake et al, 2007). Based on the results of a self-assessment instrument measuring a teacher centricity (Pampaka et al, 2007) this teacher was the most student-centred of the sample. For example,

"… there's a sense that I've achieved the purpose…I've found out what they've come with and what they haven't come with so…we can work with that now" …I want to get students to think about the math, I want students to understand, I want students to connect ideas together, to see all those things that go together and I don't think a text book did that…[ ]."

Her lessons tend to involve a mixture of collaborative group work and whole class teaching, which are used in the context of an established collaborative and inclusive classroom. She herself emphasizes that social relations in the classroom are vital for many of these particular learners, and she employs specific strategies to improve their communication with each other as well as with her. In interviews many of the learners remarked on this, how in this maths classroom everyone knows everyone else (in contrast to some other subjects like sociology etc.!) Many also refer to maths as 'fun'. One student for instance told us that the main reason she had not dropped out of College was because of the social life, and the friends in her maths class that she got on so well with.

The particular lesson that is used in this chapter is the second in the statistics unit of the programme. The students have been asked to calculate an estimated mean average for data that has been grouped by the students in different ways (so not all answers are exactly the same, but they should be approximately so.)

Table Talk

This section provides extracts of classroom talk that we use to illustrate the argument being made. The first two extracts serve to demonstrate peer talk between two students Ellen (seventeen) and Craig (eighteen years old). In the third extract their focus turns to the problem they are solving. The remaining three extracts demonstrate the argument presented here with regard to hybridity. In this first extract, Ellen and Craig are keen to spot an error in one of their workings. They were sitting at a table in a classroom set up cabaret style and the table has a microphone discreetly placed on it. The episode selected takes place an hour or so into the lesson.

C: *Please do not destroy my calculator,… I pinched this.*
E: *It's annoying.*
C: *No, it's just because it's not like your calculator.*
E: *It's not like my calculator.*
C: *It's not like your cheating,'I'm going to cheat in exams' calculator.*
E: *My calculator is amazing. Never diss the calculator.*
C: *I'll diss what I want…*

In many ways this talk is quite unremarkable and could be put down simply as two students' engagement in some fairly innocuous off-task banter while they work on the task. What we see here, however, is open, sanctioned talk in that the teacher makes no attempt to suppress their conversation, since they have some freedom to be social within the context of the lesson. The teacher did not necessarily know whether this was going on or not, the point is that the teacher trusted the students and did not need to know exactly what was going on, and by so doing sanctioned the talk.

We see their interaction regarding the calculators as serving to maintain their relationship sociality as they inspect each others' mathematical workings to jointly find where the discrepancy in their responses to the problem stem from. Ellen is frustrated with Craig's calculator because she can't work it sufficiently well, so she hits it. Craig light-heartedly takes control by asserting that the calculator is his possession and she should be careful with it (line 1). He infers Ellen is annoyed with his machine because she doesn't have the know-how to use it properly, because it is not like her own. Ellen reverses the position when agreeing that Craig's calculator is indeed not like hers, which she implies is a much better model. Craig maintains the thread but by calling hers a 'cheating calculator', both recognising that she does have the better model, whilst attributing his with integrity and arguably himself with the know-how.

Next there is an abrupt change in voice as Craig sings to the tune of 'doo,doo,dah-day' (half under his breadth) and Ellen responds to his childish slapstick with a matter of fact agreement, which swiftly brings this aside (light relief) to an end as they continue with their problem solving.
C: *Oh, Ellen smells, Ellen smells, Ellen is a smelly pants, doo-dah, doo-dah. Ellen smells of pooh! Ellen is a smelly pooh pants.*
E: *I do.*

They continue their social engagement through their voluntary efforts to pin point a discrepancy in their answers to a particular problem, and their talk becomes less colourful for a while.

C: *I'm angry now* [said ironically as Ellen is chewing his pencil]
E: *Did I just do divide? No, I didn't,*
C: *You just did times,*
E: *I've forgotten how much I like pencil.*

For a short time two strands of talk seem to develop simultaneously, though the pencil conversation is soon dropped. We also noted such interweaving of social ancillary conversations into the main thread, which is to do with the maths problem when later Ellen picks up again the 'poo talk' thread by scribbling a note that Craig smells.

C: *Yeah it is; it's a space to write them. Oh, I'm allowed it [the calculator] now, just as I've actually got to work it out.[he means he has just got it worked out]*
E: *Add it up and divide by seven. Do you divide by 7? [there are seven intervals, each of which has a frequency, so the divisor is the sum of the 7 frequencies]*
C: *Noooooo, you divide by the total number. I bet that says something weird.*
E: *Is that a 13 or a 15? I don't know.*
C: [calls over the teacher]
E: *Do you get 119? You what?* [Ellen realises Craig's answer of 20 is way off hers' of 119]
C: *Great, I've* ***got my crazy thingy there, estimated mean****, how?*

This is the first time Craig connects crazy with the estimated mean. 'Crazy' is used as an adjective. He calls the 'thingy' (estimated mean) crazy and his use of the pronoun 'my' indicates he takes ownership of his different estimate. Earlier in the lesson Craig had experienced difficulties with similar problem solving, so we speculate that maybe he is beginning to suspect that it is he who has made the error. Craig calls the teacher over for help.

T: *You've got that? Crumbs,* [She confirms that his answer is way off.]
E: *I added all them there and then divided by total frequency … got that.*
S: *Yeah it makes more sense, doesn't it?*
E *Yea!!!!* [pleased with herself – we note the friendly rivalry between the pair].
T: *Talk me through what you've done.* [Directed to Craig].
C: *I added all them together, and then divided by the total frequency, and that's what I got*.
T: *Where's 25 times 6? Talk me through where that comes from.*
C: *It's the mid point of that group.*
T: *Of which group?*
C: *That group.*
T: *100 to 150?*
C: *Yeah.*
T: *What's half way between 100 and 150, Craig?*
C: *25. 125.* [Craig readjusts is response to 125 as his arithmetic error dawns]
T: *100, yeah, there you are, you've lost all your 100s.*

Craig's error has been identified by the teacher. It was an arithmetic slip where he had mistaken the mid-point of 100 & 150 as 25 instead of 125. This slip resulted in his final estimate of 20, which was unlike the estimates from other students, which hovered around 120.

T: *Suzanne, have you finished?*
[E&C to themselves at the table]
E: *How'd you get that?*
C: *I don't know!*

T: *Could you just add those up for me? [the teacher has moved to another table]*

C: *Crazy20* [Directed towards E]
….

Here we see Craig has become more specific and his '*crazy thingy estimated mean'* becomes '*crazy20'*. We note, however, that the teacher didn't pick up on Craig's expression, so it went unnoticed within the classroom as a whole. In this sense, his 'crazy20' didn't make it beyond his table into general classroom discourse.

Community discourse crossing the boundary into classroom mathematics talk.

We see how peer discourse is used as they talk, e.g. in Ellen's use of the term **diss** a short hand for 'disrespect' and arguably the epitome of what was originally Black American peer talk, but is now widely use in some British communities. Ellen's 'intertextuality' within her discourse is typical of talk in very many conversations and situations. It is precisely because such talk is typical outside the classroom in all kinds of circumstances that it is of interest here, and indeed there are many classrooms where students draw on a range of discourses. The interest in this paper is in exploring why such talk may offer a potential for change which renders it of significance here. We note also how Ellen and Craig (both White British) use the terms crazy and weird in relation to aspects of their mathematising. For example:
C: …..The only thing you need to know about electrons is that they've got a negative charge and they do **crazy** stuff and the spin in directions.
E: yeah, **crazy.**

And in relation to 'histograms':
E: Is one of them like the … or something **crazy**, but done into a bar graph?
E: you've got to do something **crazy** with them.
E: Yeah, these boxes are **weird**. (i.e. of different widths]

The exception to this is Ellen's recourse to its standard usage when she says 'Is that because **you're crazy**?'

We suggest that ‘crazy’ is being used as a ‘filler’, in a sense ‘crazy’ denotes a black boxed procedure (i.e. any procedure, that may be highly important, which is not known or understood by the user) which may or may not be known. We do not have enough instances of the term weird, to situate it in this way, but both weird and crazy can be seen as imports from ‘peer talk’.

When Craig uses the term crazy *Great, I’ve* ***got my crazy thingy there, estimated mean****, how?* we have an example of hybridity - both ‘crazy thingy’ and ‘estimated mean’ are used in conjunction with each other when Craig draws on both his peer and mathematics discourse. Similarly, when Ellen refers to the essential distinguishing feature of histograms (compared with bar charts) as ‘weird’, she is using her genre of (or register for) peer talk to mark out and make the mathematics her own.

Later when Craig referred to his *‘****crazy 20’*** he drops entirely any reference to the mathematical terminology of an ‘estimated mean’, which has now become implicit, given the discursive context. It is a hybrid construction–crazy combined with 20. That is, “it is an utterance which belongs, by its grammatical and compositional markers, to a single speaker, but actually contains mixed within it two utterances, two speech manners, two styles...two semantic and axiological belief systems" (Bakhtin 1981:304). Such hybridity in Craig’s language use is important because it opens up possibilities for advancement or regrowth, since the talk is in a sense at the boundary or edge of two or more discourses (or systems).

Craig’s use of ‘crazy 20’ might best be described as an instantiation of organic hybridity, since there is combination and fusion within it, "but in such situations the mixture remains mute and opaque, never making use of the conscious contrasts and oppositions". This ‘unconsciousness’ might suggest a danger for the future – at some point Craig may need to become clear about the inappropriateness of such peer talk in some situations. Craig indeed remains unaware that he has used hybridized talk, however, organic hybrids can be "profoundly productive historically; they are pregnant with potential for new world views" (Bakhtin, ibid: 360). Each generation makes the culture (including mathematics) in a new form, and it can be argued that organic hybridity describes the historical evolution of all cultures (Lo, 2000). Despite having transformative potential, organic hybridity does not necessarily disrupt the sense of order and continuity, as long as the keepers of the culture accept it as his teacher does.

The term Crazy 20 then is a construction personal to Craig and Ellen, which captures the particular context of Craig’s calculation of an estimated mean as they worked jointly on the task of locating his error. The crucial thing is that the use of ‘crazy’ from peer culture has become part of the way they talk about maths itself; it has become constitutive of maths talk for them, and, hence, we claim the description as hybrid is justified. As such this goes one step further than ancillary talk, when the peer talk is accepted as OK but kept separate from the maths in the classroom. However, we also note that there was a mixture of ancillary and constitutive of maths talk at their table. So what then is the significance of ‘crazy 20’ when it comes to identification with mathematics?

Mathematical classroom pedagogic culture and identity

In some ways the pedagogic culture of Ellen and Craig's classroom is fairly atypical of our observations across the 6th form colleges and Further Education institutions, in that it was underpinned by the teachers' principles and practices (that we might describe as 'constructivist'). However, the episode we draw upon is simply that of the two students working together on individual work, which becomes a joint activity when their task becomes to spot their error.

In one sense we are stating the obvious when we point out that when the students were talking together they were being social. We argue, however, that the open acceptance of this sociality within classroom culture **is** crucial to the ways in which students will identify with mathematics. Indeed, the literature suggests that sociality might be especially important for those students whose community cultures are not well aligned with the dominant discourse of school as an institution. Hicks (2002: 2), for example, concludes that since 'the forms of action and knowledge that students embrace are strongly tied to the identities that emerge from family and community contexts, conflict can arise between an institutional system aligned with middle class practices and the life world of working class students in particular'. Alternatively, Kendrick and MacKay (2002) argue in a similar vain that when school practices do not afford 'spaces for belonging and when students are unable to place the cherished identities they live at home and outside of school in dialogue with new identities they encounter at school, they turn away to other values and practices as points of identification and connection. See also Davis (2007).

Thus, we argue that Craig and Ellen's banter about calculators and Craig's messing about with the smelly poo talk is important when it is significantly intertwined with mathematics[1]. As we saw in the extract above, doing maths becomes part of that identity-work. For instance, Craig in relation to this episode later reveals in conversation about his arithmetic error, '*but* [later] *I redeemed myself*'. Indeed, at one point towards the end of the lesson, in banter with Ellen he says '*I am a man*', both examples of which then highlight how gendered identity-work is being performed.

We note also that in this classroom, opportunities for students to draw on significant elements of their identity often go beyond their peers to include the teacher. In the following extract we show how Craig was keen to engage his teacher in a similar kind of banter to the calculator talk.

T: *Hang on. So what will that one? Was that 175, that one? I told you, you should*
have a nice table, didn't I? Who was right?
C: *Oh God.*[i.e. don't gloat over me now]
T: [*I'm glad you record this?* Directed to the researchers] *Teacher's always right!*
Oh dear.

[1] See Hernandez et al (2007) to see how students decisions to continue with mathematically demanding subjects is socioculturally complex with competing gendered, classed and ethnic discourses.

C: *You're not always right. I will prove you wrong one day. I've proved you wrong before!*

T: *I am this time. Just this once I am.*

C: *I won before, on the first day. Still remember that bloody day. I got a Mars bar for that.*

We note it is important that the teacher validates their anciliary talk by joining in, albeit she doesn't adopt the same language as they – she can be 'cool' but never truly their peer- but we see that she accepts it and understands it.

If we look at Ellen and Craig's classroom table talk (across the extracts) it strikes us that throughout the episode the peer-to-peer tenor (in Halliday and Hasan's , 1985, terms) of their conversation broadly speaking stayed the same, signifying that the relations between the two of them stays constant even when the topic of the talk changes. The notion of tenor then is important because we see then the mathematics 'field' has become entwined with that peer tenor. (For a fuller discussion of field and tenor see also Williams et al, 2007). In other words, they talk about mathematics using broadly the same tenor as when they talk about chewing pencils, albeit we would not expect the talk emerging as public in the classroom to be exactly the same as peer talk outside, in other contexts.

We suggest all this may indicate that a weakening of the classification and framing (Bernstein, 1990) of the mathematics pedagogic code, and that through more vibrant kinds of classroom mathematics talk, more sociable ways for students to be mathematics learners may be fostered. Significantly, we suggest, this opens up to the students' opportunities for moments of identification with mathematics (and by implication makes possible connections with other aspects of their lives that they hold significant, connections that we claim is necessary if mathematics is to take on significance in their lives) (cf. Cobb and Hodge, 2002).

This is why sociable mathematics may be more appealing for those students whose neighbourhood discourses are in opposition to those dominating in schools or colleges. When peer talk is not encouraged or allowed within the classroom, students may experience proportionally fewer opportunities for connection making than those students whose neighbourhood discourses are better aligned (see Davis, 2007 a and b). This also explains why what constitutes effective pedagogy may vary with social class, ethnicity, gender and other social differences (e.g. Borich, 1996 on class). Moreover, there is a growing literature stemming from research in school effectiveness (e.g. Lauder, Robinson, and Thrupp, 2002; Thrupp, 1997, 1998) that looks at the impact of what is sometimes known as a 'school-mix' effect, which considers the impact of the sociocultural make-up of the classroom on school processes and classroom practices. Therefore, moreover, it might be that effective classroom pedagogic culture may vary with neighbourhood culture so that qualitatively different productive pedagogic cultures may thrive in different places.

Theories of identity can help us to understand how subjective engagement in classroom practices, through such opportunities for moments of identification, *constitute* learners' formation of identity, which may over time include a view of

themselves as mathematical (e.g. as an enthusiastic learner of mathematics, or as a particular kind of maths person). For example Gee (1999) elucidated the reciprocal relationship between language and identity. Identity is not only about being recognized or passing as a certain kind of person; it is also about (re)constructing oneself that way. In this view, when students engage or disengage with mathematics they *also* thereby construct their 'selves' in practice. This we may refer to as identity-in practice, and is sometimes known as participatory identity (cf. Wenger, 1998, Boaler, Greeno and others). In time such participation may become realized and turn inwards to become a narrative, self-identity (see Vygotsky, 1978; Williams, Davis and Black, 2007).

Crucial then for this possibility is a pedagogy which openly encourages a peer oriented mathematics talk. That is, if we are to impact or transform ways that students identify with learning mathematics, the development of a peer aligned social mathematics holds the key – a way in, that, for some, may even enable a mathematical strand to their identity to emerge. We note how Solomon (2007) refers to mathematical identities as fragile. The role of pedagogy becomes to foster particular kinds of identification with mathematics within this social perspective.

Conclusion

In the extracts of classroom talk presented in this chapter, we did not recognise two separated peer and mathematics discourses, the one being of 'official maths', the language of the 'estimated mean' and the other (sometimes more quietly spoken and 'hidden') of everyday teenage talk. Such dual discourses can be described as a product of transmissionist style teaching whereby the division of labour places the teacher in a role as expert whose discourse (and 'classroom' tenor) is dominant at least when mathematics is voiced.

Our observational micro data shows an alternative discourse where the mathematics ***is*** social talk and a 'peer' social activity within the contexts of the mathematics classroom. We use Craig's 'crazy 20' to show how the peer sociality is appropriated into the co-production of a sociable mathematics. We argue that this social peer dialogue provides opportunities for points of connection and identification, and hence the potential for pedagogy to impact how students identify with mathematics. Such discourse practices are pregnant with potential for new world views.

We suggest that such acceptance of mathematics into the peer discourse practices of the students, (even though this may remain situated within the context of the mathematics classroom) may be the first sign in a chain of acceptance of a view of themselves as mathematical. In other words, such discourse shows that Craig and Ellen were doing maths as part of their identity work, and we take this as a sign that, perhaps, they are accepting "being a maths-person".

Therefore, we argue that developing our understanding of such a social pedagogy for mathematics may be especially crucial with regard to widening participation in mathematics. It presents learners with the possibility of multi-modes of belonging as the mathematics can align with a diversity of social discourses. We have argued that this is important regarding impacting certain ways of doing and talking about

mathematics, since a social pedagogy provides opportunities for change. We suggest, following Hicks, Moll and Gonzalez and others earlier, that failure to provide opportunities for connection with students' lived and very meaningful social identities may be especially problematic for those who may experience some dissonance within the dominant educational system.

We concur with Wenger (1998, p. 160) who suggests that one of the most significant challenges faced by learners who move from one community of practice (or space for learning) to another is the reconciliation of "forms of accountability" from those communities into one nexus. The extent to which students like Craig and Ellen can move comfortably between different communities of practice both in and outside college will depend much on their abilities to coordinate the multiple perspectives they have been exposed to. We note that the development of more inclusive practices will require attention at all levels of the education systems as more diverse practices may given rise to particular tensions should they need to perform within a more formal discourse of mathematics in the future.

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