Spaces of Values: what is available to be adopted by students

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We consider the space of values *to which students are exposed through teacher utterances in relation to the tasks provided and the nature of the interactions between with students. We restrict attention to values associated with care for mathematics and care for students because there are endemic tensions both in and between these. We are concerned here only with what is available for students to detect and internalise, not what is actually internalised. We illustrate the notion of a space of values by considering the behaviour of one teacher, selected from a group of previously studied teachers (Skilling 2013), all of whom were recognised for maintaining a high degree of engagement of their students.*

Theoretical Frame

Teaching mathematics can usefully be seen as a caring profession (Trigwell & Prosser 1996; Goldstein 2002; Mason 2002; Noddings 2012; DeVito 2006). As in any caring profession it is vital for the effectiveness of their actions that practitioners display both *care for* the people they serve and *care in* the exercise of their profession. However, there are endemic tensions: on the one hand, there is a tension between caring for the student and being seen by students to be caring for them, and on the other hand, there is a tension between caring for students and caring for mathematics. For example, wanting students to 'have fun' is an extreme form of caring for students, and while positive affect is important, 'caring only for students' can all too easily displace providing contact with significant mathematical thinking (Heaton 1992; Moyer 2002), thus losing contact with caring for mathematics (and students' mathematical development); concentrating on mathematical reasoning can all too easily leave students bewildered and frustrated (caring for mathematics at the expense of caring for students). When students struggle with a task, teachers can be tempted to simplify the task so that it can be accomplished (Stein, Grover & Henningsen 1996), which displays care for students at the expense of mathematics. Our interest is in tensions between care for both students and for mathematics, and how this care is available to students as a space of manifested values.

Care is shown through what is valued by the teacher and the institution, hence our interest in what might constitute the *space of values* accessible to students through immersion in the milieu and ethos, and through interactions with both teachers and mathematics.

In his landmark book, Bishop (1988 p. 60-81) identified three clusters of values often identified with mathematics, each with two aspects: ideology (rationalism and objectism), sentiment (control and progress) and sociology (openness and mystery). Our interest is not so much in these very general values, but rather in how more specific values are made available, transacted and even promoted through student-teacher and student-student interactions.

Bishop, Seah & Chin (2003) lay out the case for values as the focus of mathematics education curricula concerns. For example, they make the point, and refer to many other authors making the same point, that “there is widespread agreement among writers about values in education that whenever and wherever any teaching takes place, values are being taught and learned (p. 718, see also p. 721)”. But the word ‘values’ is used variously to refer to ethical, moral, political, philosophical and spiritual dimensions, as well as to social, cognitive and psychological experiences. Here we restrict our attention to the domain of mathematics: encountering and experiencing mathematical thinking in classrooms. Our interest, initially, is in what values are available to be interpreted as such by students. Thus we distinguish between values espoused in private, espoused with students, and available to be experienced by students, focusing principally on the latter, though using the former two as a guide. Of course we acknowledge that we are not privy to what attention students pay to the values that the teachers espouse and display and can only interpret this from the actions and interactions observed in the classroom.

We take our lead from *variation theory* which highlights the *space of learning* associated with tasks and interactions, focusing on ‘what is available to be learned’ because the student has experienced variation in its critical dimensions (Marton & Booth 1997). Values require a different theory however, because although it seems clear that students are unlikely to pick up unmanifested values, it is not clear how a space of values is opened up for students. It is certainly not clear that variation in enacted values, or even variation in how the same value is enacted, are necessarily relevant. Studies such as Perry (1968) and Copes (1982) who tried to use Perry positions in mathematics teaching indicate the complexity of the issue. This paper is an initial foray into this domain, using previously collected video-transcripts of teachers with a record of engaging students in mathematics.

We see values concerning how mathematics is approached and engaged in as being experienced by the full psyche: behaviour-enaction, emotions-affect, intellect-cognition, and attention-will (Mason 2003) via the construction or adaptation of one or more ‘mathematical selves’ which channel energies in characteristic ways. Thus we aim to probe beneath the surface of socio-mathematical norms (Yackel & Cobb 1996) which concentrate on practices, to consider what values are manifested. We are interested in features such as sense-of-coherence, appropriate challenge (Jaworski 1994), respect and trust so that significant mathematical and personal choices are possible, the kind of support provided during periods of frustration and not-knowing, as well as recognition of the frustrations when coming-to-know. There are obvious connections with self-efficacy, agency and many other socio-psychological constructs too numerous to mention much less integrate into this paper.

Gathering Evidence

A recent case study investigated the beliefs and practices of four teachers who were identified as promoting and maintaining engagement in mathematics classrooms (Skilling, 2013). The rationale for investigating different cases was to identify both shared and distinctive beliefs and practices amongst teachers of students with high and low levels of achievement.

The study drew upon multiple sources of data such as teacher surveys, pre- and post-lesson interviews with the teachers, and lesson observations. In this way teachers' self-reported beliefs could be compared to their observed practices. Student engagement is conjectured here to be shaped and influenced by values displayed in and through various teacher practices, including dimensions such as the nature and quality of student-teacher interactions (Skinner & Pitzer, 2012), individual teacher differences (Hardré, Davis, & Sullivan, 2008) and levels of teacher support for students (Midgley, Feldlaufer, & Eccles, 1989). The teachers all expressed belief that student engagement was an important element for learning mathematics (e.g., through responses to a Teacher Beliefs and Practices Survey (Skilling, 2013)) which was reflected by their use of supportive positive motivational factors in approaches to lesson planning and responses to students' needs (Anthony & Walshaw, 2007; Doig, 2005; Sullivan, 2011).

As with the construct *space of learning*, there is no claim that students were influenced by the values displayed. Our aim is to find a way to describe what is available to be experienced, so that later studies can explore what values are taken up by students, under what conditions, and in what ways.

Methods

We considered data from several teachers but because of limited space, selected a short segment from one teacher's classes which seemed to us to highlight most clearly a range of values. In a longer paper we could have offered data from several teachers and chosen longer and different sequences, and these might perhaps have shown further variation. Our concern here is with the notion of space of values, not a comprehensively phenomenographic study of such spaces. The video-transcript was trimmed down to teacher utterances while viewings of video recordings generated detailed descriptions of events and actions, although we are well aware that there were other things going on at the same time which could impinge on values. We then considered the range and the degree of repetition of various utterances and actions which we think display values.

Because this is only an initial enquiry, it is not appropriate to undertake any form of triangulation or testing of inter-rater reliability when analysing transcripts, although the initial study (Skilling, 2013) incorporated these.

Mr. Tower

For this paper an excerpt from one observed lesson (lasting from the 6th to 13th minute of the 50 minute lesson) has been selected in order to explore details of how Mr Tower's behaviours, utterances and interactions with his students, revealed his care for both students and mathematics and how these values were displayed during the lesson. The lesson was on the topic of mass, and included discussions on what was meant by mass, units used commonly (in Australia) to measure mass, relationships between units, converting from one unit to another, and assigning units when weighing objects. The class was one of two higher achieving classes in Year 7 as assessed by the school at time of entry to secondary school, and Mr Tower reported that he was mindful of maintaining a good pace of learning to meet what he considered to be the learning needs of these particular students. The excerpt comprises all his utterances over the period (see Appendix A) which involved identifying, ordering, abbreviating and converting units for measuring mass.

For the present study, the authors were interested in examining what seemed to be valued by Mr Tower concerning how mathematics is approached and engaged with, as he went about interacting with the students in his class. His instructional style included phases of asking students to record their thoughts on mini-whiteboards, discussing individual responses with other students, clarifying concepts for and with the class, and providing time for individual students to reflect on and make adjustments to their understanding of concepts. He usually walked around the room reiterating the task request, praising student efforts, affirming student progress and attending to individual students who he assessed as requiring support.

Overall analysis

Several overarching values were interpreted as being displayed. First, a wide range and variety of largely consistent values were displayed throughout the chosen lesson segment, indicating something of the depth and complexity of events and interactions occurring in learning environments. Second, the timing and frequency of particular values was a particularly notable feature. Some of the values displayed were interpreted by us as predominantly orientated towards displaying caring about mathematics, others were interpreted as being predominantly orientated toward displaying caring for and about the students, while others combined both, or could be taken either way. The range and extent of these suggest that, being multiply construable, how they influence students' adoption of corresponding values is likely to be complicated. Although recognising that the same act can be interpreted as displaying a range of different values, the following discussion aims to describe what and how the values portrayed were meaningful in terms of learning mathematics and for students as learners of mathematics. T-codes refer to the data which is in the appendix.

While any action initiated by a teacher can be considered to exhibit concern if not care for students' mathematical wellbeing, and justified as such, we distinguish between actions for which the focus is predominantly the correctness, structure and meaning of the mathematics and actions for which the focus is predominantly the students state, which includes cognitive, affective, enactive and attention-focus.

Values particularly associated with caring about mathematics

In this category we place actions and utterances that we interpret as being focused on clarification, emphasis on conventions, on students' utterances being mathematically correct or appropriate, on feedback apparently aimed at exposing everyone to correctness, and on making or promoting connections with prior concepts.

In the excerpt, values of class and individual construal and meaning making were often combined. For example, when Mr Tower asked students to record words used to describe units of mass, to order units of mass, and to recall abbreviations for units of mass (T1, T7, T12) he appeared to value not only what individual students construed but the extent to which the whole class made sense of the concepts. This aligns with the notion Davis (2005) put forward of the teacher as the 'consciousness of the collective'.

We interpreted mathematical organisation, connections and conventions as being valued throughout the lesson, as, for example, when Mr Tower asked students to "order" units of measurement "lightest first" (T6), and by asking students "what is the connection between" (T12) and "how would you show how you might change or convert" (T17), the students were challenged to demonstrate and connect what they knew from prior learning experiences. Mathematical conventions were valued when abbreviations for different units were clarified (T11) and the connection between units established (T12). Mr Tower sought to clarify terminology and processes by asking students to re-state concepts (T5) or by re-stating concepts himself (T5, T11, T14).

Many of these values would only emerge as values if they were to occur repeatedly, or if they were treated to scaffolding and fading (Seeley Brown, Duguid & Collins 1989) by making prompts increasingly indirect so that students begin to internalise them for themselves (Love & Mason 1992). On the two occasions that Mr Tower was observed teaching, consistency with the values he portrayed about caring for mathematics was evidenced by the emphasis he placed on being clear and precise, and on connecting mathematical ideas. The way that students responded throughout the lessons to the questions and tasks asked by Mr Tower indicated that the value of caring about mathematics was adopted as a 'normal' expectation in this classroom.

Values particularly associated with caring about students as learners of mathematics

Practices which we interpret as indicating caring for students include: providing regular class and individual affirmation and praise; opportunities for reflection and self-regulation; alleviation of anxiety; acknowledgement of persistence; maintaining interest; acknowledging task difficulty; and opportunities for collaboration. Many of these practices are discussed as affective factors in terms of motivation engagement research, and certainly attending to students emotional needs is crucial for influencing learning outcomes (Hannula 2004).

Mr Tower demonstrated his interest and valuing in assessing student progress on numerous occasions stating that "I am going to get you to show me" (T1), and asking student to hold up their work so that he could gauge student thinking (T3, T7, T9 and T20). This could be interpreted as caring for the mathematics over caring for students where students might feel embarrassment or negativity about being asked to expose their thinking to others, but we did not detect any such reluctance or negativity: everyone asked seemed content to expose their thinking. This is in alignment with the notion of a conjecturing atmosphere (Mason 2003).

Associated with assessment, both feedback and clarification were provided during the lesson, which can be interpreted as concern for students to understand fully, but could be interpreted as testing students' understanding. Upon observing that some students had identified four units of measurement and others three, rather than correct individuals, he stated that "Some have written more than others" (T4) and asked the class to share and consolidate the four units of measurement that they would be expected to use.

Value judgements in the form of affirmation of students' progress were observed as being directed both toward the whole class as well as towards individual students. For example, comments such as "Most people are doing that very well" (T3) were directed to the class, whereas "Good, all correct" (T14) was directed to the student who was asked to complete work on the board at the front of the classroom. It was also observed that Mr Tower repeatedly affirmed student progress with combined general comments such as: "Right. Good. Okay" (T3, T4, T6, T9, T13, T18 and T21). However, on a number of occasions these affirmations were more explicit such as: "Everyone is on target' (T3); "Most of you have got this" (T13); "Some of you have got the idea"; and "I like what I see guys. This is very good" (T20). Whether these utterances become a weakened currency due to their frequency would be a matter of further study by listening to what students have to say. His constant movement around the classroom looking at individual's work could be interpreted as coercive, or as displaying care for students. However, it was observed that students did not hide work and in many instance offered their work for Mr Tower to see, which suggests that the students valued and felt comfortable with having their mathematics work checked over.

Mr. Tower took several opportunities to show that he valued students reflecting on their learning. For example, students were encouraged to “have a look around and see other people’s [work]” (T20) and make adjustments to their work by collaborating with their classmates (T10, T13 and T20). Additionally, student self-regulation was encouraged (“You might have to change your whiteboards now if you didn’t quite get that”, T15) indicating that student autonomy and clarity of concepts were valued. Again, the practice of viewing the work of others emphasised the importance that Mr Tower placed on ‘collective’ understanding of concepts by everyone in the class. We could infer that Mr Tower’s values for caring about mathematics underpins his caring about individual understanding and he extends this notion of caring to include all the members of the class. In this way not only are his values for caring about mathematics displayed, but he is modelling to his students that each of them should also care about their own and others mathematical understanding.

Alleviating possible student anxiety showed care for students’ affect: “If you’re not sure, you’re not sure. That’s okay” (T8) and checking for full student clarity was indicated by “Did everyone hear that? Who wants it said again?” (T5). Mr Tower also displayed valuing challenge: “Okay, these are hard questions. This is going to challenge some of you” (T16). Coupled with challenges Mr Tower also supported students by acknowledging their efforts (“I know you will do your best”, T2) and persistence, as well as the need for variety: “We are going to do a little bit more with me and then we are going to get you guys to do some” (T19). Apart from affirmation throughout this part of the lesson, Mr Tower’s final remark of praise was linked to values of expectation and satisfaction signalling that the class were ready to move on to the next phase of the lesson: “Alright, that’s brilliant. Well done guys. So, we are ready to convert” (T21).

Tentative Conclusions

The same action by a teacher can be interpreted positively, neutrally, or negatively by students. For example, being asked to expose your working to the whole class can be seen as positive in a conjecturing atmosphere focused on learning and developing, as neutral when simply accepted as a classroom practice, and as negative when the emphasis is on correctness and competition. Indeed different students may interpret the same act differently. What really matters is how the classroom ethos is developed and practices introduced, including the stance taken by the teacher through what is said and done to indicate what the teacher values.

We are struck by the complexity of the range and intensity of values that are available to be interpreted by students from immersion in different classroom practices and milieu. Any *space of values* being displayed and made available to be adopted by students can be nullified through inconsistency, neutralised through becoming an un-reflected-upon practice, or exposed through repetition, meta-questioning, and through the tenor of the relationships that the teacher has with the students and with mathematics, and how these play out together.

We suspect that it could be useful to teachers and teacher educators to become aware of unintended values being interpreted by students from habitual classroom behaviours (ways of working, ways of speaking) which are not in alignment with espoused values. This could inform pedagogical choices involving both the selection of tasks and ways of interacting with students and with mathematics, including being mathematical with and in front of students.

Our initial analysis also indicates that trying to assign specific values to specific actions will be less fruitful than maintaining the complexity of human interactions. Sometimes care for students and for mathematics are in tension, and sometimes they are in harmony.

What we have learnt from this initial foray into considering values for caring about mathematics and caring about students as learners of mathematics is that it is not so much the utterances themselves, nor even the actions of which they form a part, but the entire ethos of the classroom that is likely to influence how students interpret the values being enacted and whether these are taken up as values or acceded to as practices. It is also likely that students go through periods of frustration as well as elation, and it is how these energies are perceived and handled that is likely to influence students.

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Appendix: Mr. Towers' utterances

T1	"I want you to write down the words we use when we measure mass" REPEATS "All the words you can think of". "Write them down and then I am going to get you to show me"
T2	"Don't worry about spelling, that's okay. I know you will do your best"
T3	"Good, most people are doing that very well" ; "Okay, hold them up so I can see them" ; "Good. Right. Okay. Everyone is on target"
T4	"Some have written more than others. Hands up those who wrote three names down? Who wrote four? Good."

T5	"What are the four?" Student A: "Grams, kilograms, tonnes and milligrams". "Did everyone hear that? Who wants it said again"
T6	"I want you to write them in order, those four words, lightest first – lightest first". "Good. Okay. That's good. Okay"
T7	"Now before I get you to hold them up, I want to see if you know their abbreviations. Write the letters that abbreviate them next to the words"
T8	"If you're not sure, you're not sure, that's okay"
T9	"Let's see, let's go—hold them up! Very good, very good."
T10	"Check it with the person next to you as well. Have a look at theirs".
T11	"Right, so you should have had: milligrams in brackets mg, grams in brackets g, kilograms in brackets kg, and tonnes in brackets t. How do you say that word? Some say t**o**nnes but we will say tunnes—we are used to that"
T12	"Now we are going to see what the connection is. I want to see how much you know about this. What is the connection between grams and milligrams?"
T13	"Good. Most of you have got this" REPEATS (Checking individuals' work) "Check with the person next to you"
T14	"Sarah, go out and write the answers on the board at the front for me. Good all correct. One thousand, one thousand and a thousand. Thank you" "Is she right?" Class responds "Yes"
T15	"Very good. So, you might have to change your whiteboards now if you didn't quite get that. So they were all a thousand"
T16	Stands at the front, pauses and holds out hand to gain students focus. "Okay, these are hard questions. This is going to challenge some of you".
T17	I want you to come up with a creative way of how you would show how you might change or 'convert' (points to this word on the board) grams to milligrams, kilograms to grams and tonnes to kilograms". Re-phrases: "How might you combine all of that information to say I am going from tonnes into kilograms, kilograms into grams and then the reverse?" "Now you have seen this before and you could repeat it but you might be able to come up with your own way. How could you connect?"
T18	"Okay, some of you have got the idea. Very good, very good. A lot of you have remembered past ways of doing it"
T19	"Okay, I have been out here working for a long time. We are going to do a little bit more with me and then we are going to get you guys to do some"
T20	"Right, show it to the person next to you. I like what I see guys. This is very good. If someone next to you has got it wrong or they have made a little mistake…give them a little bit of support…now hold up…have a look around and see other peoples as well"
T21	"Alright, that's brilliant. Well done guys. So, we are ready to convert"