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The "Third Wave": Values associated with Effective Learning of Mathematics in Australian Primary Classrooms

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The study reported here is the Australian component of an international research project which seeks to identify student-reported convictions co-valued by them and their teachers during moments of effective mathematics learning. The 2 teachers and their 12 students in the 2 primary school classes associated effective moments of learning with 13 different values. No gender difference was apparent. Although the teachers planned their lessons together and were teaching similar topics, there were differences in what were co-valued. Of the 13 values, examples, sharing, resources, and multimodal representations were found to be commonly valued by students across the 'ability' groups, while the others related to particular 'ability' groups only.

Keywords: values, effective learning, Australia, primary school
MESC Classification: C20, C60, D30, D40
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BACKGROUND AND CONTEXT

The study reported in this article is the Australian component of an ongoing 11-institution, international research project called *The Third Wave: Study of values in effective mathematics education*. Conducted over the years 2009–2011, the project was conceptualized to explore how the adoption of a values perspective to investigate effective mathematics learning might constitute a third approach, complementing the current knowledge we have constructed through the cognitive and affective research approaches. The collaboration in this larger project of researchers from 11 different institutions in 10 countries/regions is expected to enhance cross-cultural understanding of data collected at a time when school (mathematics) classrooms around the world become

increasingly multicultural. The comparable sets of data grounded in the different countries/regions will also facilitate cross-cultural comparison studies amongst the countries/regions, namely, Australia, mainland China, Hong Kong, Macau, Malaysia, Singapore, Sweden, Taiwan, Thailand, and USA.

This article reports on the sense-making of what teachers and students co-value in effective mathematics lessons in Melbourne, Australia, wherein the students identified the times during the lessons visited when they found themselves learning mathematics particularly well. It begins with a discussion of the ideas of effectiveness and of values in the context of mathematics learning/teaching, as well as the role of interactions in the classroom pedagogical process. A brief outline of the research design is followed by the presentation of the results that had been collected. The interpretation of these results is shared in the last sections of the article.

EFFECTIVENESS IN MATHEMATICS PEDAGOGY

An influential study into effective mathematics pedagogy in the late 1990s has been the "Effective Teachers of Numeracy" study (Askew, Brown, Rhodes, Johnson & Wiliam, 1997) conducted with 90 primary school teachers and more than 2,000 students in the UK, in which relatively high mean achievement gains were found to be not necessarily related to specific teaching styles. Instead, (the research team's interpretation of) effectiveness appeared to be associated with teachers who had 'connectionist' orientations (as opposed to 'transmission' or 'discovery' orientations), focused on students' mathematical learning (rather than on provision of pleasant classroom experiences), provided a challenging curriculum (rather than a comforting experience), and held high expectations of initially low-attaining students.

Many of the features listed above reflect the valuing of meaningful and constructive classroom interactions between teacher and students, and perhaps also amongst students. Indeed, students connecting with the subject as well as with peers and teachers is one of the characteristics identified as making the difference to numeracy attainment within classrooms in a large-scale, 65-school project in New South Wales, entitled What's 'making the difference': Achieving outstanding numeracy learning outcomes in NSW primary schools (Australia DEST, 2004).

The various international comparative studies such as the "Third International Mathematics and Science Study" or "Trends in International Mathematics and Science Study" [TIMSS], and "Programme for International Student Assessment" [PISA] generally arrive at similar conclusions that effective teaching is more about responding to and valuing the socio-cultural aspect of the learning environment than it is about adopting

particular teaching methods. Hollingsworth, Lokan & McCrae's (2003) analysis of the TIMSS 1999 Video Study data revealed that successful teaching of mathematics in schools has not been found to be associated with any one pedagogical method; in fact, it was evident that amongst the high achieving countries a variety of teaching methods had been employed. At the same time, the PISA 2003 data indicate a small net effect of the impact of school policies and practices on student performance, to the extent that it is insignificant compared to such effects as socioeconomic factors (OECD, 2004).

> "Taken together, the students' characteristics, the socio-economic background of students and schools, the students' and school principals' perceptions of the school climate, the school principals' reports on school policies and practices, and the assessment of the availability and quality of educational resources, as measured by PISA, account for 8 per cent of the variation in the average performance of OECD countries" (OECD, 2004, p. 256).

Studies such as those discussed above do imply that effective teaching/learning of mathematics involves relatively macro-level valuing of relevant convictions (such as the connectionist orientation to teaching), rather than any one particular teaching method. At this macro-level, these convictions are understandably non-context-specific. Thus, while a context-free quality such as technology might be valued in a classroom situation, there can be various context-specific ways in which this is enacted. In this instance, it is likely that effectiveness is facilitated through socially-mediated practices and norms that are responsive to the unique socio-cultural context of the classroom. Put differently, two classes with their inherent differences can both produce effective teaching and learning through the common valuing of a macro-level, context-free quality, but actualised through differential actions and norms at the micro- and context-dependent level. The socio-cultural constructs of values, then, can potentially help us to further structure the framework relating to effective mathematics pedagogy.

VALUES IN MATHEMATICS EDUCATION

In mathematics education, values are "the deep affective qualities which education fosters through the school subject of mathematics" (Bishop, 1999, p. 2). They represent "an individual's internalisation, 'cognitisation' and decontextualisation of affective constructs (such as beliefs and attitudes) in her socio-cultural context. Values related to mathematics education are inculcated through the nature of mathematics and through the individual's experience" (Seah, 2005, p. 43). They are the personal convictions which an individual regards as being important (Seah & Kalogeropoulos, 2006) in the process of learning and teaching mathematics.

Seah & Ho (2009) worked with 62 and 48 first-year pre-service primary teachers in

Melbourne and Singapore respectively, inviting them to reflect on their own school mathematics education experience, and to draw their mental pictures of what the most effective moments of mathematics learning looked like. Being first-year pre-service teachers, the students had just completed formal schooling, and had yet to be formally introduced to pedagogical methods and traits. Values inherent in and expressed through the drawings were interpreted first by the individual researchers, then analysed together. Amongst the most-frequently valued convictions across Melbourne and Singapore, 3 were common, namely fun, whole-class interaction (see also, Shimizu, 2009), and group interaction. Values that were common and others that were unique to both education systems were interpreted in terms of the respectively socio-cultural contexts.

Given this sharper focus on the role of values and valuing in optimising the effectiveness of mathematics teaching and learning, then, there appears a need to investigate specifically what the common big-picture, macro-level, context-independent premises are which get valued in effective classrooms. From a sociocultural perspective, however, the classroom is one example of a community within which complex interactions and discourses take place, where subjective intentions and decisions are contested and negotiated on a regular basis. It is to this aspect of interpreting the process of mathematics teaching and learning we now turn.

CLASSROOM INTERACTIONS

Teacher-student and student-student interactions that invariably take place during mathematics lessons constitute part of the mathematics educational practices within the classroom. These communicative social interactions are means by which people negotiate their situated meanings (Gee, 1999) of teaching and learning mathematics, and are necessary to frame the different zones of proximal development of the participants involved. Lerman (2001) highlights the often-ignored fact that teachers are also pulled into their own zone of proximal development in such interactions; they learn through these professional practices which they craft for their students. At this structural level of learning context (Vygotsky, 1978), values reflecting the various social structures such as the school and family are exposed to one another (Brooks, 2004). Situated meanings are the by-products of negotiated values which underlie teachers' professional and social histories and experiences, as well as students' personal and social histories and experiences. It is thus reasonable to propose that the pedagogical activities taking place within a classroom are representative of social mediation and negotiation of what each participant regards as important. It is precisely the desire of and intention by participants of the mathematics lesson to enact and emphasise what they individually value which

bring these values together, sometimes in consensus, other times in conflict. Nevertheless, this co-construction of classroom practices “can be conceived as being in a mutually supportive relationship” (Shimizu, 2009, p. 79). In negotiating what need to be valued by the class as a whole, the convictions that are emphasised eventually can be perceived as being co-valued by both the teacher and his/her students.

Adopting this view of co-valuing in individual classroom environments suggests that existing literature identifying values of effective mathematics classrooms need to be complemented by new research that complicates the pedagogical processes intentionally. It is in this light that this study seeks to shed light on the following research questions:

(a) what convictions are co-valued in the classroom environment when students find themselves learning mathematics particularly well?
(b) how are these values negotiated and co-emphasised by the teacher and his/her students?

RESEARCH DESIGN

This qualitative research study has been framed such that data were collected from 2 teachers – Kellie and Yasmine–from the same primary school, thereby controlling for the institutional context. As it turned out, the two teacher participants were not only teaching the same level (grade 5), but they also planned their lessons together. Given that the students were not streamed into the various classes at any school level, the two classes are indeed similar in many ways, which allowed for a sharper focus on the teachers’ respective roles in negotiating the range of values that played out in their own classrooms.

For each participating teacher, 6 students from her class were identified as potential student participants, based on teacher-nominated pairs of students exhibiting high, average and below average ‘abilities’ in mathematics learning. Parents of all these 12 students consented to their children taking part in this study.

Data collected were triangulated in two ways, namely through the use of multiple data sources (lesson observations, interviews, and artefact analysis), and through the inclusion of cross-checking mechanism within each data source.

3 lessons lasting about an hour each were observed for each class over a period of one month. During these 6 lessons, the student participants were invited to identify moments when they found themselves learning mathematics particularly well. These ‘moments of effective learning’ would serve as stimuli of conversations during the focus-group discussion sessions after the lessons, conversations guided by semi-structured interview questions investigating what get co-valued by students and teachers in effective mathematics learning, and how. To stimulate student recall, each student participant was

given a digital still camera, trained in how it might be used with the flash disabled, and encouraged to capture the 'moments of effective learning' on film from their perspectives as learners. Thus, the photographs provided visual snapshots of highly valued moments in mathematics pedagogy as seen from students' eyes and angles. Student 'control' over the nomination of 'moments of effective learning' was greatly enhanced by the provision of the cameras, or as Lim (2010) calls it, the enabling of 'photo-voice'.

The teachers' contribution was via the completion over a month of a teacher journal, as well as a semi-structured interview session after each student focus-group conversation session. Prompts in the teacher journal encouraged teacher participants to reflect and share what the features of their respective teaching practices were, and what might be regarded as important and worthy of being valued. Scheduling the interview sessions after having talked to the students had allowed for cross-checking with the relevant teachers aspects of academic interest that arose in the lessons observed and in the focus-group conversations earlier.

Lesson fieldnotes and digital audio recordings of both forms of interview sessions were transcribed into verbatim format immediately after each research site visit. Tentatively identified values and clarification questions were thus able to be followed up with the relevant teacher / student participants in the next research site visit, through the use of questions such as "what do you regard as being important to you …?" and "does this show that … is important to your teaching/learning?"

As alluded to above, preliminary analysis of data collected took place between visits to the research sites. The cross-checked information that was subsequently gathered was transcribed and added to existing data files. All data were then analysed through a multiple-pass approach, utilising the three-stage open, axial and selective coding that typifies the grounded theory research approach suggested by Strauss and Corbin (1990).

RESULTS

As mentioned above, the methods of observations, of individual and focus group semi-structured interviews, and of artefact analyses were employed in this study to investigate classroom negotiation and co-valuing of convictions that teachers and their students considered important in effective mathematics learning and teaching.

Kellie was an experienced classroom teacher with 8 years of experience, having taught in two different schools and across different year levels. She was a mathematics leader in the school visited. On the other hand, Yasmine was a 'first year out' teacher, having completed a pre-service primary education degree the year before. There was very close professional communication between Kellie and Yasmine, and planning lessons together

was one of these articulations. The school in which Kellie and Yasmine were practising in was located in an outer suburb of metropolitan Melbourne; the school was only three years old at the time of the data collection. Its location in a high-growth corridor in the state has meant that student populations have been huge across each of the seven year levels from Prep to Grade 6. Thus, many of the parents sending their children to the school are Generation Y-ers, and represent a multitude of ethnic cultures.

Table 1. Values associated by students with moments of effective mathematics learning

Values	Kellie’s class		Yasmine’s class	
	male	female	male	female
examples	KS1	KS3 KS6	YS1 YS4	YS2 YS3 YS5
sharing	KS1 KS5	KS2 KS4 KS6		YS6
resources			YS4	YS2 YS3 YS5
multimodal representations	KS5	KS2 KS3		
	KS5	KS3 KS4 KS6		KS5
fun	KS1		YS4	YS2
doing mathematics			YS1 YS4	
efficiency				YS2 YS3
competition			YS1	YS2
questions		KS3		YS4
certainty				YS6
hints				YS2
working out myself			YS4	

The values that have been identified by students as being associated with moments of effective mathematics learning are listed in Table 1 according to classes, gender, and teacher-nominated student ‘ability’ levels. In the Table, student codes (*e.g.*,YS3) ending

with 1 and 2 refer to students from the high 'ability' group; 3, 4, average 'ability' group; and 5, 6, below average 'ability' group. The values are also presented in 3 groups through the use of the thicker dividing borders, namely, values that were embraced by students across all 3 'ability' groups, values embraced by students across any 2 'ability' groups, and values embraced uniquely by students in particular 'ability' groups.

Content analysis of interview transcripts, journal entries, and field notes shows that during the data collection period, the 2 participating teachers and their 12 students were observed to emphasise 13 different values corresponding to effective learning and teaching moments known to them. These relate to different aspects of the teacher-student interactions during the lessons. For example, while the valuing of examples and resources are mathematics educational in nature (see Bishop, 1996), whereas the valuing of sharing can be regarded as being both mathematics educational and educational. Also, of the 13 values, 4 were observed operating across the 2 classrooms, with the remaining 9 being classroom-specific (1 in Kellie's, 8 in Yasmine's).

The 13 values have been listed according to the extent students from different 'ability' groups had identified them as associating with effective moments of learning. That is, in this study, a conviction that is valued by students across 'ability' levels will be regarded as being more significant than one that is valued by a lesser number of 'ability' levels.

Frequency counts with its associated implication of relative emphases amongst the various values were not recorded, since it can be problematic to assume that pedagogical content and activities provide equivalent opportunities for different values to be embraced. A frequent valuing of sharing in effective mathematics learning may mask the fact that the frequency counts were contributed by one particular student. Furthermore, some other equally significant values embraced by the particular classroom might not find as much opportunities for expression during the data-collection period.

In examining patterns in the data that might be explained by student gender and 'ability' levels, the analysis was conducted across both classrooms to account somewhat for the already small sample size of 12 students overall. This was facilitated by the fact that both the participating teachers in this study have been planning lessons together, such that the same lessons were visited across Kellie and Yasmine. Thus, students of both gender and of all 'ability' levels were experiencing similar classroom learning activities, so that gender- or ability-related differences should have similar opportunities to surface across both teachers' lessons.

Observations arising from the data analysis process relate to the forms of values in practice, the ways in which different values were evident in the two classrooms, the values which were common across and unique within student 'ability' groups, and the contestation of values in teacher-student and student-student interactions. These will be briefly discussed below.

VALUES AND FORMS OF PEDAGOGICAL PRACTICES

The data analysis process has revealed a range of forms which particular values can take on. For example, Kellie’s students’ valuing of *sharing* was operationalised through peer sharing as well as through students going up to the whiteboard to explain their reasonings. The structuring of appropriate stimulus questions during the focus group interviews had facilitated this common value to surface as different classroom activities were discussed. Student participants KS4, KS5 and KS6 were able to identify this value regardless of the form of classroom activities which articulated it. As discussed earlier, then, the values perspective has allowed us to more usefully identify what are common characteristics across effective mathematics pedagogy. However, the other 2 student participants in Kellie’s class reported their valuing of *sharing* as it related to one particular classroom activity; it is as if the value was implicit in certain forms of classroom activities. In this sense, then, it appears that a teacher’s scaffolding of such enabling values needs to be reflected in a variety of learning experiences. There are certainly implications here for the setting up of ‘toolkits’ of teaching ideas, so as to foster flexible and varied harnessing of these ideas to optimize the mathematics learning across a range of learning styles and student abilities or dispositions.

VALUES SUPPORTED BY THE TWO TEACHERS

Lessons in the two teachers’ classrooms were similar given that Kellie and Yasmine planned their lessons together. This brings to sharper focus situations when a conviction is valued by many students in one class, but not in the other. Within the data, the valuing of *sharing and explanation* were overwhelmingly reported by Kellie’s students, whereas Yasmine’s students reported the valuing of *resources* in their effective learning of mathematics. Given that the student ‘ability’ levels in the two classes were similar, this observation suggests that there was a greater co-valuing of sharing and *explanation* in Kellie’s class, and of resources in Yasmine’s, during the data-collection period. Resources as co-valued in Yasmine’s class takes the form of the availability of resources in different modes around the class and in the delivery of lesson content to foster student understanding, such as posters of mathematical terms, visible availability of mathematics manipulatives, and student access to tools such as calculators. It appears then that Yasmine’s pedagogical scaffolding activities were at a more concrete level than Kellie’s, when the latter’s emphasis on sharing and *explanation* promotes interactions at a more abstract level.

VALUES ACROSS GENDER

Analysing the data according to student gender, there appears to be no evidence to suggest that boys and girls value different convictions as they found themselves learning particularly effectively. In each class, 2 boys and 4 girls participated in this study. This ratio between boys and girls is also reflected across the values shown in Table 1.

However, the two boys in Yasmine's class value *doing mathematics and working out myself* when their female peers do not, and when the other peers in Kellie's class (including the boys there) do not. Does this imply that Yasmine's practice facilitates the co-valuing of values relating to students doing the mathematics themselves which are especially effective learning activities for male students?

VALUES ACROSS 'ABILITY' GROUPS

Student participants across the three teacher-nominated 'ability' groups had identified different values they commit to when they found themselves learning well during the mathematics lessons. In particular, all three 'ability' groups of students across the two classes had identified the valuing of *examples, sharing, resources and multimodal representations* (in order of decreasing number of students subscribing to each) when they found themselves learning mathematics well. Additionally, the high and average 'ability' students also valued *fun, doing mathematics, and efficiency*, whereas the average and below average 'ability' students valued explanation. The high 'ability' students were also unique in their valuing of competition and hints, whereas their peers at the other end of the spectrum valued certainty. *Questions and working out myself* were identified by the average 'ability' students only. It is also worthy to note that none of the values was commonly embraced by high and below average 'ability' students. While the valuing of the same convictions by students in 'neighbouring' ability groups reflects the fine line that might separate the groups, this difference in what is valued by the high and below average 'ability' students also highlights the priorities that differ amongst different learners, and how their learning may be best facilitated.

To the extent that these were co-valued by their respective teachers, the degree of overlap between what were valued by the average 'ability' students and by their peers in the other two ability categories provide a sense of how Kellie and Yasmine might cater to different ability groups within their own classes. That is to say, Kellie and Yasmine's valuing of *examples, sharing, resources* and *multimodal representations* in their respective pedagogical practices facilitate student learning particularly well across the

range of student achievements. This is a significant finding for mathematics teaching practice, given the oft-heard concern amongst classroom teachers today of the challenges of catering to the learning needs of a wide range of student ‘abilities’. That most of the research into this area of mathematics pedagogy appears to be conducted in the 1980s and 1990s (see, for examples, Linchevski & Kutscher, 1998; Slavin, 1987) has added some sense of urgent need for updated academic knowledge to be made available. This finding points to the potential for the values perspective to support existing approaches to fostering effective and meaningful mathematics learning experiences for students across different ability groups.

Additionally, the findings in this study also indicate what students of particular ‘ability’ groups value when they were learning mathematics particularly well. Although students of similar school levels in Australia had been found to value *fun* and *explanation* predominantly in mathematics lessons (see Seah & Ho, 2009), purposive sampling of student participants in this current study has allowed for a richer understanding of how these two values were valued by students of different ability groups, specifically, the high/average and average/below average ‘ability’ levels respectively. Those students from the average ‘ability’ level value both fun and explanation probably explain the high incidences of these values being reported in Seah and Ho (2009). This finding has implications for teachers facilitating the mathematics learning of particular groups of students, in terms of what values might be included and emphasised in the teaching discourse. Similar conclusions might be inferred from the high ‘ability’ group’s valuing of *competition* and *hints*, and of the below average ‘ability’ valuing of *certainty*.

CLASSROOM INTERACTION BETWEEN TEACHERS AND STUDENTS, AND AMONGST STUDENTS

As mentioned earlier, classroom-specific values were identified in the two classrooms, despite the fact that the same lessons were taught at the same time, and that the two teachers planned their lessons together. It is reasonable to argue, then, that the classroom culture as a function of teacher and student characteristics and as a function of the interaction of these, is shaped by the different values that are emphasised in these sites. The data collected in this study provide clues to what such negotiations of classroom culture might look like, resulting in teacher and student co-valuing of particular qualities that support mathematics teaching and learning respectively.

An example pertains to the teacher-student and student-student negotiation of the extent to which (mathematical) *language* should be valued in Kellie’s mathematics lessons. Although Kellie appreciated the educational value of emphasising to her students

the importance of articulating the right fraction language, co-valuing of *language* by her students apparently took time to develop.

> Sometimes I will actually be very frank with them and say, "you need to know this language, because you are not going to understand it when you get to another teacher." And they go, they sit up and go, "okay, now I really need to know. She's [Kellie] been fairly harsh." And once I do that, they go, "okay," and they take notice, and they think that's important, whereas if I don't put an importance on it, they'd just go, "okay, that's not that important." (Kellie, KI3 0138-0256)

Such negotiation of different values that are brought into the classroom discourse has certainly not been unidirectional. For Kellie, for example, there are times when

> I kinda listen to them [her students] a little, and goes, "well, this is what they t hink is important or they do, so I try to manipulate it to the way they like it. (Kellie, KI3 0135-0148)

Teacher and student negotiation of value differences invariably involves the contestation of values, and is certainly not a straightforward process. In Yasmine's class, for example, her valuing of *listening* (to one another sharing their mathematical ideas) had meant a pedagogical approach that was in conflict with her students' valuing of (teacher) *explanation*. Her attempts at facilitating group activities to emphasise the pedagogical potential of *listening* was challenged by students wanting her to explain the relevant mathematical content to them instead. One reason why Yasmine valued *listening* was that

> It's like I'm not an expert [in mathematics], and sometimes I don't know the answer. So I'll encourage, like, …. I mean, everything we're investigating at the moment like in Grade 5, 6, I pretty know, but if a word comes out, we'll sort of investigate together. (Yasmine, YI3 0932-1001)

At the same time, Yasmine also felt the pull towards the valuing of *explanation* in her practice, which she attributed to the relative lack of professional experience (given that she was in the first year of her teaching career).

> When you were saying that they [the students] value what I'm saying, and how I explain it [the relevant mathematical concept], I think a lot of it comes up to, probably being first year, but I think, "oh, they need to know this by the end of the year possibly." I mean, to get that out, I need to teach them all of these things. I don't know if I, I mean, I guess it'll take time to … I want to get better at them not relying on me, and so it's kinda scary that they do rely on me …. I don't want to feel like I'm regurgitating answers to them. I don't want them to be thinking like that. That is a bit scary. (Yasmine, YI3 1131-1216)

Yasmine did not appear to have resolved this contestation between her valuing of *listening* and the valuing of *explanation* by her students and herself. That she appeared to

value both listening and explanation, and that these convictions were in conflict in this context, probably added to the complexity. Indeed, *explanation* was identified by one of the student participants in her class as being a value that facilitated effective mathematics *learning*. In the meantime, Yasmine’s practice featured both values. Yasmine’s valuing of listening seemed to be a response to the uncertainty she felt of her content knowledge, whereas the valuing of *explanation* on her part appeared to be due to a relative lack of professional experience. It is possible that for Yasmine, this contestation of values would be resolved over time. However, given the reasonable argument that professional experience contributes to the confidence in one’s content knowledge, it would be interesting to see how the contestation between student *listening* and *explanation* might take on a different form as professional experience increases, since there will likely be a corresponding de-emphasis on listening and *explanation* then!

DISCUSSION

This study has been designed to explore the shared convictions in primary school mathematics classrooms that are valued by students when they are learning mathematics effectively. The privileging of student voice in identifying the moments of effective learning during a lesson represents a research methodology which seeks to make sense of effective mathematics pedagogical experiences through the opinions and views of students, with an aim of complementing existing academic knowledge that privilege the voice of teachers and other adult stakeholders only (*e.g.*, Anthony & Walshaw, 2008; Bryan, Wang, Perry, Wong, & Cai, 2007; Opdenakker & van Damme, 2006). In order to promote student recall and to enhance the validity of the data collected, student participants tagged the moments of effective learning during the lessons visited with a still photographic image, using the digital camera provided to them.

The analysis of data collected from interviews and observations has given rise to two main findings. The first finding relates to the values which students associate with effective learning during a mathematics lesson. The assumption made here is that rather than the form of pedagogical practices, it is the values underlying these classroom practices which align themselves with what are co-valued by the teacher and students that ‘make the lesson clicked’ at particular points during a lesson. The methodology of this study has allowed for more meaningful learning compared to an earlier, similar study (see Seah & Ho, 2009). While students generally value *examples*, *sharing*, *resources*, and *multimodal representations* when mathematics is learnt effectively, students in different ‘ability’ groups across the two classes visited also valued additional convictions which are particular to each ‘ability’ group. Both ‘types’ of values are of significance; while the

four values associated with effective mathematics learning listed above may empower teachers to plan learning activities that are engaging for the different students in the class, values identified in this study that are associated with high, average, and below average 'abilities' might be harnessed in situations where the learning experiences of particular groups of students are targeted.

The second finding acknowledges the extent to which values are personally internalized, and adds an additional layer of meaning to the first finding. The research methodology design of this study has ensured that data was collected from 2 classrooms that are similar in most aspects other than teacher characteristics. The equivalent number (about 25) of students in each class represented a wide range of mathematics 'abilities'. In fact, the teachers planned the lessons together, and these similar lessons were delivered on the same days. That the teachers experienced differently the contestation of values in negotiating their respective pedagogical discourse in class highlights the personal nature of values, pedagogical or personal. What this study has found is that as a result of these teacher-student negotiations of the convictions that were valued, different sets of values were embodied in the lessons. Thus, although *sharing* was valued by students across all three 'ability' groups, and indeed all except one student participant in Kellie's class associated *sharing* with effective mathematics learning personally, none of the student participants in Yasmine's class shared this valuing, even though there were opportunities for student sharing in Yasmine's lessons. This finding emphasizes the teacher's role in interpreting and in meaning-making of the form of pedagogical practices, activities and tasks in their professional practice. The underlying processes involving the contestation and negotiation of values between teacher and students, and amongst students, are understandably complex. This study has reported how both teacher participants viewed these negotiation processes, and further research will be targeted at understanding how these processes work, how teachers can possibly regulate them to further enhance their pedagogical practices, and/or how educational leaders might optimize the deployment of teacher resources available to them.

It should be mentioned that the de-emphasis on particular, student-identified values in the discussion in this section has been deliberate. While the validity of these values as underlying nominated moments of effective mathematics learning has been enhanced through cross-checking with relevant student participants during subsequent interview sessions, the generalisability of this list of 13 values is constrained by the scope of the study, both in terms of participant numbers (14) and in terms of duration of on-site data collection (4 weeks). The strengths of the two findings reported here are not affected by the specifics of the values that are associated with moments of effective mathematics learning. Further research attention will aim to identify a more representative list of values, however, so that even more understanding and knowledge of the crucial roles

played by values in fostering effective mathematics pedagogy (*e.g.*, how these vary in cross-cultural contexts, how students of different ‘ability’ groups value enabling convictions differently) might be attained.

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