QUALITIES CO-VALUED IN EFFECTIVE MATHEMATICS LESSONS IN AUSTRALIA: PRELIMINARY FINDINGS

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This report is part of a study being conducted with Grades 5 and 6 students in primary schools in Victoria, Australia, exploring the qualities that are co-valued by teachers and their students in particularly effective mathematics lessons. Effective mathematics lessons is a function of productive interactions between students and their teachers in their respective sociocultural settings. That such interactions involve the mediation of choices and negotiation of decisions imply that aspects of mathematics lessons are co-valued by lesson participants. The data show that the co-valuing of mathematics educational and institutional qualities in effective mathematics lessons is more significant than the co-valuing of other qualities. Differential perceptions between male and female students were also interpreted.

INTRODUCTION

Effective (mathematics) teaching is undoubtedly an important – if not the most important – objective in school mathematics education. This paper recognises that effective mathematics lessons/teaching/learning may be labelled differently, such as excellent teaching (AAMT, 2002) and successful lessons (Sullivan, Mousley, & Zevenbergen, 2006). Much – if not all – of what constitute pre- and in-service teacher education courses is aimed at facilitating more effective pedagogical practices amongst teachers-to-be and teachers respectively. Teacher professional accreditation (and promotion) exercises in different countries are also structured based on teacher demonstrated professional practice. For example, in Australia, the ‘Standards for Excellence in Teaching Mathematics in Australian Schools’ (Australian Association of Mathematics Teachers, 2002) “describes what teachers who are doing their job well should know and do” (AAMT, 2002, p.1). In the USA, the NCTM Standards advocates for effective curriculum, teaching and learning.

This paper presents a small part of a study being conducted in Victoria, Australia which explores the qualities (pedagogical or otherwise) that are co-valued by teachers and their students in effective mathematics lessons. Instead of focussing on the values that teachers of mathematics and their students subscribe to individually, the study looks at what are being co-valued in lessons that optimise mathematics learning in the primary schools, and it also aims to unpack the implications of key similarities and differences between perspectives of teachers and students.
EFFECTIVE LEARNING / TEACHING OF MATHEMATICS

Despite the many different ways of defining and ‘measuring’ effective mathematics teaching (through, for examples, test scores, growth in student understanding), the very notion of ‘effectiveness’ remains to be an elusive concept. Effective teachers need not be equally effective with different grade levels or different cohorts of students. Indeed, effective teachers might be good at adopting different pedagogical actions to different learners in the same classroom. Also, the extent to which teaching/learning effectiveness can be measured validly through achievement outcomes alone (e.g. due to examination anxiety) is debatable, though, paradoxically, one might even expect assessment to be reflective of effective learning!

Thus, not only is teaching/learning an interaction, but effective teaching/learning might be a function of such interactions between teachers and their students, between and amongst students, and between the class and its environment. Waldrip, Timothy and Wilikai (2007) highlighted “that relationships in teaching are of prime importance. As the teacher works to establish rich communicative relationships with students … more is revealed to them about one’s teaching and the more credible to the students becomes the teaching” (p. 118). This view to effective teaching implies that any attempt by a teacher to enact any ‘list of attributes of effective mathematics teaching’ needs not make the teacher more effective; the compatibility of the sociocultural environments concerned is likely going to be an important factor instead. Yet, much (mathematics) research advocates teaching ideas which assume learners as being equally ready cognitively, and/or assume that the learning contexts are similar or unproblematic, when “students will respond differently …. [Thus], while teachers can anticipate variable responses to the tasks from the students in their planning, there is also an explicit requirement that the teaching itself be both dynamic and interactive” (Sullivan, Mousley and Zevenbergen, 2006, pp. 119-120).

Just as it has been productive for us to think about teacher interacting rather than teacher teaching, the same applies to thinking about how/why a teacher does what he/she does, rather than what the teacher does; from thinking about effective mathematics lessons rather than effective teachers.

This view of mathematics pedagogy is embodied in curriculum statements like the aforementioned Australian Standards. Instead of identifying specific attributes associated with excellent teaching, the Standards point to broad characteristics demonstrated by such teachers. For example, statement 3.1 advocates that “in an inclusive and caring atmosphere of trust and belonging, active engagement with mathematics is valued, communication skills fostered, and co-operative and collaborative efforts encouraged” (AAMT, 2002, p.4). While key qualities that are valued in effective teaching are identified; there is no attempt at dictating how, say, communication skills are to be fostered. In this way, it recognises that the professional workplaces of different teachers necessitate the use of different strategies to foster such skills amongst the learners. It also acknowledges that communication is valued in
effective classrooms, along with *inclusion, care, trust, belonging, engagement,* and *co-operation.*

**VALUES RELATED TO MATHEMATICS EDUCATION**

Values like those above are context-free (Seah, 2005). These values guide the adoption of context-dependent beliefs, which in turn determine teacher actions to realise the values. Thus, in valuing *communication,* say, a teacher may subscribe to the belief that ‘learners need to explain their problem-solving strategies in written solutions’, while another teacher may hold the belief that ‘learners should discuss their responses to problems with peers’. That is, a teacher is effective not because certain beliefs are subscribed to; the same belief applied in another learning setting may not be successful. Rather, it is likely that a teacher facilitates an effective lesson by guiding the negotiation, mediation and co-valuing of enabling qualities with their students.

In conceptualising effective mathematics lessons as a function of interactions between and amongst participants of the learning/teaching process, there is a recognition that the negotiations conducted by teachers with their students (and vice versa) in structuring effective learning environments are involved with the weighing of available choices and mediating of decisions. Both choosing and decision-making are key to valuing (Bishop & Clarke, 2005; Raths, Harmin & Simon, 1987). Thus, what get co-valued by a teacher and the students in any mathematics lesson (rather than what each of them values) play a significant role in helping us understand better the extent to which the lesson is effective.

Seah (2005) had identified the relevance of organisational or institutional values (e.g. *professional development, numeracy*) in school mathematics learning/teaching, adding on to Bishop’s (1996) categories of mathematical (e.g. *control, progress*), mathematics educational (e.g. *practice, multiple representations*) and educational values (e.g. *respect, honesty*). Certainly, there are values which belong to multiple categories. For example, *creativity* may be embraced within all the four categories of values operating in mathematics lessons.

The significance of values and valuing in mathematics education research should be understood from two different perspectives. In one, values in mathematics lessons may be seen as a means of realising broader educational goals. Mathematics lessons are regarded as vehicles for students’ learning of civics and moral knowledge, citizenship and other pedagogical aims. In fact, this is one of two emerging forces challenging the generally-held view of mathematics as being culture- and value-free (Wong, 2005). Incidentally, this aspect of values research in mathematics education was also acknowledged in the 2007 Psychology of Mathematics Education’s annual conference, through its theme of ‘school mathematics for humanity education’.

In the other perspective, the concept of values is explored in the context of optimising learners’ outcomes through teacher/student valuing of particular values (as in this
study). Here, the various categories of values are seen to be vehicles for mathematics learning, understanding, attainment or achievement.

If effective mathematics lessons are a function of interactions as described above, and given that constructivism (in its various forms) acknowledges the co-construction of knowledge between teacher and learners, then it is instructive to hear from both these groups of participants with regards to what get valued in effective mathematics lessons. Yet, what we know about effective mathematics lessons appears to be overwhelmingly based on the perspectives of teachers (see, for example, Hayes, 2006) and/or educators (e.g. Crawford & Snider, 2000). This research has been designed to also tap into students’ perceptions to complement interaction techniques.

**METHODOLOGY**

This paper reports on a part of the quantitative component of the mixed-methods study outlined above. In particular, the data source for this component was constituted by 5-page questionnaires each of which consists of 9 open-ended items, the analysis of which is expected to shed light on the opinion of upper-primary (Grades 5/6) students in relation to what are the qualities that are co-valued by participants of effective mathematics lessons.

All but one of the items ask for students’ written responses in the spaces provided in the questionnaire. The one item invites the student respondent to reflect on a particularly effective mathematics lesson he/she had experienced over the past few years, and to draw in the space given what that particularly effective mathematics lesson looked like. Prior to responding to the questionnaire, a whole-class discussion of what the term ‘effectiveness’ means in the context of (mathematics) lessons was facilitated in each class.

Children’s drawings as a data source have been utilised in psychology and sociology research (Yuen, 2004), but relatively seldom in education research. Yuen (2004) lists several advantages in using children drawings as data source, amongst which include the provision of a relaxed atmosphere, a greater insight into the perspectives of children, the avoidance of groupthink, and working round the language barriers faced by some student respondents. The limitations of this data source as identified by Yuen (2004) were addressed in the design of this research. For example, the threat to research validity due to children’s dislike of or perceived inability to draw was reduced by telling the student respondents that each of them had the choice to skip any questionnaire item, including the first item. This research also acknowledges the difficulty for anyone to draw emotions and/or multi-sensory experiences, through the inclusion in the questionnaire of other items that allow for cross-referencing of student responses.

A total of 118 Grades 5/6 students from 5 classes in 2 suburban primary schools in Melbourne completed the questionnaire survey. The students generally experienced no problem in responding to the items, except for the observed difficulty amongst many
students in spelling. Students were then assured that they could raise their hands to ask for assistance in spelling individual words.

The first twenty questionnaires were jointly analysed by me and a colleague so that the subsequent discussion of our inevitably value-laden interpretations could lead to a socially-negotiated analysis framework. It is also noted that cross-referencing the content of the questionnaire items further validated the interpretations.

**WHAT EFFECTIVE MATHEMATICS LESSONS VALUE**

Students’ perceptions of the values that operate in effective mathematics lessons were elicited from an analysis of their drawings and textual responses. Table 1 is a list of 5 qualities most identified or inferred (by students) as being valued in effective mathematics lessons in the primary school. In order of proportion of student nomination, these qualities are fun (66.7% of the students surveyed), teacher experience (58.5%), boardwork (50%), instruction/explanation (50%), and interestingness (33.1%).

It is worthy to note that amongst the categories of values discussed earlier, effective mathematics lessons in the Australian primary school classroom appear to value highly qualities that are either mathematics educational or institutional in nature. One of these institutional values (i.e. experience) also relates to teacher attributes. In fact, all the three institutional values relate more to the teacher than to the other institutional factors (such as school or education boards), thus highlighting the significance of teacher-student relationships in fostering effective (mathematics) lessons (see, for example, Waldrip, Timothy and Wilikai, 2007).

<table>
<thead>
<tr>
<th>Valuing of …</th>
<th>Value category</th>
<th>n (%)</th>
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<tbody>
<tr>
<td>fun</td>
<td>institutional</td>
<td>79 (66.7%)</td>
</tr>
<tr>
<td>experience</td>
<td>institutional</td>
<td>69 (58.5%)</td>
</tr>
<tr>
<td>boardwork</td>
<td>mathematics educational</td>
<td>59 (50%)</td>
</tr>
<tr>
<td>instruction / explanation</td>
<td>mathematics educational</td>
<td>59 (50%)</td>
</tr>
<tr>
<td>interestingness</td>
<td>institutional</td>
<td>39 (33.1%)</td>
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Table 1: Primary students’ perspectives of qualities that are highly co-valued.

This is not to say that educational and mathematical values are not emphasised at all in effective mathematics lessons. However, it does imply that mathematics lessons that are particularly effective value the pedagogy of the subject and the structuring of the learning environment more than emphasising the more general educational values or those characteristic of the mathematics discipline. Does this imply that effectiveness is associated with more instrumental values (i.e. mathematics educational and institutional) at the expense of less instrumental – and more realistic perhaps – ones (i.e. mathematical and educational values)? Does this mean that the attained
curriculum or measures of (effective) teaching value the utilitarian quality of lessons, rather than the more aesthetic ones? Is the relatively less important roles played by mathematical values a reflection of the level of content knowledge of primary school teachers of mathematics)? Similarly, does the relatively less important roles played by educational values add to the findings in Clarkson, Bishop, FitzSimons and Seah (2000) that teachers need greater support in integrating values teaching / education in mathematics lessons?

It is also important to remind ourselves that the qualities that are perceived by the students as being valued were valued in the interactions that took place as the lessons unfolded, rather than being valued by these students individually. In acknowledging students’ perceptions of what counts as an effective mathematics lesson in this study, the data was also interpreted by student gender to shed light on whether male and female students perceived effective mathematics lessons to be valuing different qualities, and if so, how this difference looks like. The 69 female students associate effective mathematics lessons with 70 different values, while their 49 male peers see these lessons as being associated with 60 different values. Similar to the whole-group analysis, effective learning / teaching in these two data sets seem to value the mathematics pedagogical, educational, and institutional aspects of lessons, while no student related effective mathematics lessons with the mathematical nature of the discipline (i.e. the mathematical values).

Some qualities that female students associate with effective mathematics lessons are not regarded in the same way by the male students, and vice versa. Most significantly, only female students (49 of them) see effectiveness as being related to interacting with others, whether it being pair-work, group-work or whole-class settings. Also, the 25 students who value the teacher attribute of humour in effective mathematics lessons are all girls.

<table>
<thead>
<tr>
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<th>n (%)</th>
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<tbody>
<tr>
<td>fun</td>
<td>institutional</td>
<td>45 (65.2%)</td>
</tr>
<tr>
<td>boardwork</td>
<td>mathematics educational</td>
<td>39 (56.5%)</td>
</tr>
<tr>
<td>whole-class interactions</td>
<td>mathematics educational</td>
<td>30 (43.5%)</td>
</tr>
<tr>
<td>experience</td>
<td>institutional</td>
<td>25 (36.2%)</td>
</tr>
<tr>
<td>interestingness</td>
<td>institutional</td>
<td>25 (36.2%)</td>
</tr>
</tbody>
</table>

Table 2: Primary female students’ perspectives of qualities that are highly co-valued.

Tables 2 and 3 list the qualities that are highly valued in effective mathematics lessons as perceived by female and male students respectively. The valuing of fun, boardwork, and (teacher) experience in effective mathematics lessons is not only very often identified by the student respondents as a group, but also appears to be very significant for male and female students alike. On the other hand, the differences of the values in effective mathematics lessons between the male and female students are in line with
prior observations that the former group tends to be more task-oriented, and the latter, social-oriented (e.g. Seegers & Boekaerts, 1996). In fact, the female students’ association of effective teaching/learning with whole-class interactions is not only unique to them, but a significant one for the group as well.

<table>
<thead>
<tr>
<th>Valuing of …</th>
<th>Value category</th>
<th>n (%)</th>
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<tbody>
<tr>
<td>experience</td>
<td>institutional</td>
<td>44 (89.8%)</td>
</tr>
<tr>
<td>instruction / explanation</td>
<td>mathematics educational</td>
<td>39 (79.6%)</td>
</tr>
<tr>
<td>fun</td>
<td>institutional</td>
<td>34 (69.4%)</td>
</tr>
<tr>
<td>boardwork</td>
<td>mathematics educational</td>
<td>20 (40.8%)</td>
</tr>
<tr>
<td>symbolic representation</td>
<td>mathematics educational</td>
<td>20 (40.8%)</td>
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Table 3: Primary male students’ perspectives of qualities that are highly co-valued.

The data presented here adds to prior knowledge about the task-orientedness / social-orientedness gender difference in two different ways. Firstly, qualities that are perceived by both gender as being highly valued in effective mathematics lessons may also be categorised as task- or social-oriented, and the fact that they are so perceived by both gender indicates that some features of task and social-orientations are independent key ingredients of effectiveness in mathematics teaching / learning. After all, and secondly, the qualities identified are valued in ways which are co-constructed and negotiated by participants in the mathematics classroom, rather than being what the individual male/female student values.

CONCLUDING REMARKS

A small part of a bigger study has been presented in this paper to allow for a focussed examination of what students perceived as being valued by teachers and students in effective mathematics lessons. While curriculum statements and teacher accreditation documents emphasise the importance of both pedagogical understanding and positive learning environment in the provision of effective mathematics teaching, the students’ perceptions as identified in this study further reinforce these aims, since relatively more instrumental qualities (institutional and mathematics educational) are valued more significantly in effective mathematics lessons. In revealing what exactly some of these might be as valued by both teachers and learners in particularly effective mathematics lessons, three of these qualities (i.e. fun, boardwork, experience) appear to be highly valued across diverse classroom situations, but there are also observed differences along gender lines. The implications of this for gender-based pedagogical considerations are even more significant now given that the data presented here reflect students’ views. Ongoing research in the other phases of this study, especially data obtained from teachers commonly associated with effective mathematics lessons, promises to help us understand better the notion of effectiveness in mathematics learning / teaching as a function of classroom interactions between teachers and...
students, and amongst students, as well as the specific qualities that are valued in such interactions as they are negotiated by participants involved.

References

Australian Association of Mathematics Teachers (2002). *Standards for excellence in teaching mathematics in Australian schools*. Adelaide, Australia: AAMT.


Yuen, F. C. (2004). "It was fun ... I liked drawing my thoughts": Using drawings as part of the focus group process with children. *Journal of Leisure Research, 36*(4), 461-482.