ONLY TWO MORE SLEEPS UNTIL THE SCHOOL HOLIDAYS: REFERRING TO QUANTITIES OF THINGS AT HOME

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Children bring a wealth of mathematical knowledge from home to school but sometimes this knowledge may not be utilised in the most appropriate way. In this paper, one six/seven year old girl's home interactions over 20 weeks about measurable quantities are presented. It would seem that most of the interactions used terms to compare discrete amounts with an undiscussed norm, with only a few interactions involving units of measurement. There were no references to reading a scale, except in regard to time. Time was discussed in far greater detail than any other attribute. Although time is considered to be difficult to learn because of its abstract nature, it may in fact be an easier concept to start with when introducing the sense of how units of a quality are related to each other.

THE INTERCHANGE OF HOME AND SCHOOL MATHEMATICAL KNOWLEDGE

Many children arrive at school with significant mathematical understandings (Clemson & Clemson, 1994). However, the challenge is how to build on "this rich base of mathematical experiences in ways that acknowledge and support the family's role" (Clarke & Robbins, 2004). In order to do this, we need to understand how mathematics is used in the home and how these experiences change as children become older. In this paper, I examine a six/seven year old child's interactions at home around measurement ideas over the course of twenty weeks. Although she had been at school for two years, there was still frequent communication between home and school. For this child, amounts of different qualities were discussed in different ways. Discussions of time were some of the few occasions where units were used and the only occasions where units were compared and contrasted. Yet the unit concept is often considered something that should be taught in regard to other measurement attributes such as length, before introducing time units (NZ Ministry of Education, 2007). Consequently, there is a need to query assumptions about how to introduce measurement units that build on children's home experiences.

Most research into mathematical practices at home has concentrated on young children, generally preschoolers, and number concepts (Vandermaas-Peeler, 2008; Gifford, 2004; Clarke & Robbins, 2004). Once children start school, although the influence of home activities is still acknowledged as being important, less is known about the types of activities done and how they could connect into formal school mathematics development.

Socio-cultural approaches about acquiring mathematical understanding at home are now seen as adding useful background to how children become mathematically

competent (Benigno & Ellis, 2008). Using socio-cultural ideas, Street, Baker and Tomlin (2005) developed the *ideological model of numeracy* so that they could better describe why there might be differences between home and school numeracy practices. Table 1 describes the four inter-related dimensions of the model.

Dimensions	Description
Content	The mathematical concepts, such as measurement.
Context	The situation in which a numeracy practice takes place.
Values and Beliefs	The participants beliefs about how numeracy practices should progress and how new skills and knowledge are taught within them.
Social and Institutional Relations	The overarching factors that channel what are seen as appropriate choices in the other three dimensions.

Table 1: Dimensions from the ideological model of numeracy (Street et al., 2005)

This model is useful as an analytical tool as it provides insights into whether a simple transfer of mathematical practices can occur between home and school, or whether explicit discussions about differences between home and school need to occur. For example, in an earlier paper, I discussed how the child seemed to have more control in her interactions at home than she did at school (Meaney, 2008). This may have been because different power relations exist in the home situation compared to those between a student and their teacher and even between mother and child in a school setting. The interactions discussed in that paper also showed how the power relations interacted with the values and beliefs of the participants about how mathematical practices should be conducted. Therefore, the dimensions of the model can provide useful insights into why differences occur and the sorts of discussions that are needed if home mathematical practices are to be acknowledged in school.

Although the influence of context, values and beliefs and social and institutional relations is reasonably well known (Benigno & Ellis, 2008), the influence of content is not so clear. Measurement concepts have not received any specific attention when considering mathematical practices in the home. This is despite the fact that there have been recent calls in Hawai'i to redesign the early years school mathematics curriculum so that it focuses on measurement ideas before introducing number (Dougherty, 2003). Although some measurement concepts do appear in the data of some projects (Clarke & Robbins, 2004 for example), these are not discussed explicitly in regard to the implications for formal school mathematics teaching. It may well be that as a consequence, teachers teach about measurement presuming that students have had certain experience at home, whilst at the same time ignoring the experiences that students may actually have. Therefore, exploring the measurement concepts used at home is a rich area for investigation.

METHODOLOGY

Research about home mathematical practices has tended to rely on parents' nominated examples (Blevins-Knabe & Musun-Miller, 1996) and to some degree on them documenting them through diaries or photos (Clarke & Robbins, 2004). These methods have raised concerns about parents' ability to recognise mathematical interactions (Bottle, 1999). In some cases, parents and children have been recorded in laboratory situations where they have been provided with toys and other props (Vandermaas-Peeler, 2008). This non-home setting may well have affected the data that was collected. Bottle (1999) used a video camera to film interactions as they happened in the home and felt that it allowed for more comprehensive data to be collected. She visited each family for approximately two hours every four months. However, she also acknowledged that the intrusive nature of the researcher's videoing activities may have influenced the activities that were recorded.

For this research, it was decided to audio tape the interactions of a six/seven year old child in order to investigate how she acquired the mathematics register at home and at school. Given the amount of recording that was done, video recording would not have been logistically possible. Although only one child was recorded, this was done consistently over half a year and produced an enormous amount of data.

The child was recorded for one day a week, for twenty weeks, in the second half of 2005. From when she woke in the morning until she went to school, the research child wore a lapel microphone connected to a digital voice recorder. During her mathematics lesson, she was again recorded and the class discussion captured on another voice recorder connected to a conference microphone. After she was collected from school, the child wore the voice recorder until she went to bed. The child's parents are Samoan speakers but English was the primary language spoken at home. The mother was the research assistant for this study and organised recording the child's interactions. Her mother listened to all of the recordings and sent to a transcriber those she believed were worth transcribing.

The mother's awareness of the purpose of the project could have influenced the types of activities done at home. However, most of the time the child seemed unaware of the microphone and that she was being recorded. Therefore, although the set of transcripts may not be a true representation of the mathematics interactions that occurred, they are a rich alternative source of data to that collected by other methods.

TALKING ABOUT AMOUNTS

In the transcripts, more interactions made reference to size or amounts of things than to number. The attributes discussed included height, depth, volume, space, mass, heat, speed, tightness, strength, loudness, and amount. However, these quantity references are not easily connected to what Buys and de Moor (2008) described as the "basic pattern of the learning-teaching trajectory" (p. 23) for measurement. This trajectory includes three stages:

• measuring through comparing and ordering

• measuring through pacing off using a measurement unit

• measuring through reading off with the help of a measuring instrument (p. 25)

Many of the interactions used measurement terms as specific amounts "big girl/little girl" (Week 3) where an implicit comparison was made to an undiscussed norm. This does suggest an order, but no examples of explicit ordering occurred in the transcripts. There were also no instances of comparisons between items using expressions, such as "bigger than" or "more than". What was evident was that measurement terms often appeared in relationship to actions such as "turn the volume down" (Week 2). In the transcript from Week 3, a connection is made about the research child's brother being too tall to walk under a table.

Mother: Oh come here, ah you bumped your head. Oh dear, oh dear. Did you see he bumped his head? Watch where you're going. You're tall, see you're too tall to walk under that.

Research Child: Then he went on the ground, he went like this, mum.

Mother: Oh, he fell down. He used to be able to just walk under it because he was short but now

This extract shows that a comparison is made between the height of the table and the toddler, but the emphasis seems to be more on *walking under* than on the differences in height between the child and the table.

Sometimes, some of the terms suggested that there was a continuum of amounts; often this came through the addition of "bit" to an expression such as in "a bit chilly". The following extract comes from Week 8 where the discussion is about how something's mass could result in a cushion popping. Different animals are discussed, showing a sense of ordering the animals according to their varying masses However, there is no explicit discussion of what is being compared and therefore no actual ordering of the animals. The lines indicate where speech was not clear enough to be transcribed.

Mother: I thought the one [activity] that you jump on the blue cushion would've been fun.

Research Child: Too bad you're not a child.

Mother: ___ blue cushion.

Research Child: 'Cause then you'll pop it. [Mum laughs]

Mother: I'm not that heavy, it's a big cushion. ___ after would pop it, not me, I'm not fat.

Research Child: ___ .

Mother: Who do you think? Maybe someone as big as a whale.

Research Child: A whale would really pop it.

Mother: If a whale jumped on it, it would definitely pop.

Research Child: And we'd all get hurt.

Mother: If an elephant jumped on it, it might pop.

Research Child: Then we might all get hurt.

Mother: What other animal do you think might pop it?

Research Child: Giraffes wouldn't. What about antelope?

Occasionally, units were used to describe the amount of something. Generally, these were whole units, "two, three big teaspoons" (Week 18) that could not be broken down into smaller units, even when discussing the unit of a half. The following extract comes from Week 6

Mother: If you're hungry you can have one of the mandarins.

Research Child: Then can I have a scone, half?

Mother: ___ half.

Research Child: Half is the same, half is a half.

Time

The exception in the interactions was in discussions about time. Of all the attributes, time was talked about more often and for longer periods. The discussions were around all three stages outlined by Buys and de Moor (2008). In regard to comparing and ordering, there were also examples involving an implicit comparison. For example in the Week 5 transcripts, the mother wants to go out.

Mother: What time does that program finish? Does it take long?

Research Child: No, not very long.

Mother: Good.

Although there were still no discussions about activities taking longer or shorter than other activities, there were occasions when the time taken for certain activities was discussed. The following comes from Week 7.

Mother: Alright, you do need to think Research Child, to stop us from being late all the time, what time do you think you should get up in the morning?

Research Child: 6 o'clock.

Mother: (Amazed and unbelieving sound) Six, but you don't have to be at school until 9? Wouldn't that be too early?

Research Child: Don't worry, just stay there until it opens.

Mother: That's three hours before 9 o'clock, it's too early.

Research Child: How about 7?

Mother: That's not too bad. How long does it take you to get ready, like, get your clothes on and brush your teeth?

Research Child: Well I'm not sure about 7 o'clock, 'cause that's the time when you get ready, and 8 o'clock was when it's only two things we do.

Mother: What?

Research Child: Just all we have to do is, you know, you do my hair and do my face.

Mother: What about breakfast?

Research Child: Yeah, we'd, it'd, um, 7 o'clock we do breakfast.

Mother: You don't eat breakfast until you're dressed.

Research Child: Yeah, then, dressed, break.., I mean, brush your teeth, breakfast, ___ and then do my hair, face, yeah. Is that, is there anything else?

Mother: Shoes?

Research Child: Do my shoes up.

Mother: Pack your bag.

Research Child: Pack my bag and then go.

Mother: Alright, so then what time do you get up in the morning?

Research Child: Still 7 o'clock.

Mother: 7 o'clock. Are you sure you can do that?

Research Child: I'm not sure.

Mother: (laughs) You can try. Well if you can't, 7.30 is alright.

Research Child: Yeah, 7.30.

Mother: 'Cause it's not too early.

Research Child: Let's go at 7.30.

Mother: No that's when you wake up. Wake up at 7 or 7.30? I think 7.30 is realistic, 'cause we used to do that, and by the time it's 8.30 you'll just be eating and ready to go, and you would have finished eating.

There were several discussions around specific units of time – minutes, hours, days, weeks, months, seasons and years. Whilst watching television, during week 9, the Research Child says to herself "Only two more sleeps until school holidays". She used units of time, 'sleeps', to think about an upcoming event.

Over the course of the twenty weeks, the mother began teaching her daughter how to read both an analogue clock and a digital clock. By the end of the year, the child had just about mastered being able to read an analogue clock. The following extract comes from Week 13.

Mother: Research Child, come and see what time it is by looking at the clock.

Research Child: Something to 9.

Mother: Good girl. How many minutes? Can you count?

Research Child: Mmm. Oh wait. Can I have it down because I can't see it properly.

Mother: You only ___ __ under 12. How many dots are in between that little space?

Research Child: 5?

Mother: Yeah – good! Now what does that tell you? 5 what. What does that mean?

Research Child: 5 to 9.

Mother: Good girl. 5 what to 9? 5 hours? 5…

Research Child: Minutes?

Mother: Good girl. 5 minutes to 9. Because what happens when the big hand gets to the 12?

Research Child: It means that it's 9 o'clock.

Mother: Good girl. See – you're learning fast. If the long hand was on the 1, it would be… and the little hand ___ ___.

Research Child: It would be 1 past 9.

Mother: Are you sure it would be 1 past 9? How many minutes is the gap?

Research Child: Oh no. That gap is… 5?

Mother: Yeah.

Research Child: 5 past 9.

Mother: What if the long hand was on the 2?

Research Child: It would be 10 past 9.

Mother: Good – and what if it was on the 3?

Research Child: Yeah, but 15 isn't on it.

Mother: No – you can't see 15, but each gap remember is 5. So it's like 5, 10, 15…

Research Child: Oh, so it does count 15?

Mother: Yeah!

Research Child: Oh. Is it 15 past 9?

From interrogating the data, it was clear that discussions about measurement were frequent with a range of different attributes. Although there were references to units, these were few and there were no references to reading measurements from a scale. Time was the major exception to this. It was discussed more often than any other

attributes and the way it was discussed included all three of the stages suggested by Buys and de Moor (2008) in their learning trajectory.

DISCUSSION

Buys and de Moor (2008) suggested that length is the most primary of physical quantities to measure. This is because "[n]ot only is it available to children's perception, it is the most indicative quantity people want to find out about all sorts of objects" (p. 18). Time on the other hand is considered more abstract where the children need to develop a sense of time before they could learn to tell the time. It was therefore extremely interesting to find that in the twenty days of home discussions that time was much more prominent than length.

Street et al.'s (2005) ideological model of numeracy can provide insights into why time has such a prominent role in these home interactions. The *social and institutional relations* seem not to be different regardless of the content of the conversation. However, what is discussed at home is influenced by perceptions of what is "normal" to discuss in the home. The mother clearly believes that it is at home where the child should learn about time. Given the child's facility with number and counting (as seen in Meaney 2008), this may no longer be considered something that needs as much attention at home. The other social and institutional relation that impacts on why time has become important is that the research child is constantly late for school which has implications for the child and her family and how they are perceived by the teacher and the school more generally. In order to continue being seen as a good family who supports their child's education, attempts were made to improve the situation, such as the discussion from Week 7. For the child to take some role in ensuring she meets the expectation that she will arrive before the first bell, she needs to be able to read a clock and speed up her activities appropriately.

Having accepted the need for the child to learn about time and specifically how to read a clock, the mother makes some unconscious decisions about how to introduce it so that the child acquires the necessary knowledge. Although other units of time are used more generally, such as "sleeps" for example, the mother used a "school-like" discourse to teach her daughter how to read a clock. Given that the mother has experience as a teacher, albeit a secondary English teacher, then using formal instructions may well be something she can draw upon. However, it is interesting that reading a clock face is the only occasion where she chooses to use such skills.

In discussions that involve references to attributes, it is clear that context of being at home results in an emphasis on the actions related to the attributes. Even in the discussions about time, the context relates to actions – decorations come down because the child's birthday is over but will go up again for Christmas. This is likely to be different to school where comparing items, such as the size of feet, is done for the sake of the comparison, not because it is related to another action. Context therefore does have an impact on how the activity is framed (Benigno & Ellis, 2008).

There are some interactions where an implicit comparison about time is made in the same way as there was in the discussions about other attributes. However, the nature of time means that it is actually difficult to discuss it without referring to specific units – years, months, weeks, days, hours, and minutes. Getting a sense of time (Buys & de Moor, 2008), actually means becoming familiar with units of time and how they are related. Content does interact with context, values and beliefs and social and institutional relations. This was the case for all the measurable attributes, but in the transcripts was particularly so for time.

USING HOME MATHEMATICAL PRACTICES IN SCHOOL

These transcripts come from interactions with one child over the course of 20 weeks and are not representative of what may occur in other households. However, these do raise questions about how to make use of home mathematical practices in school.

The transcripts suggest that a belief that length is the primary physical quality may not in fact match what children experience in their home situations where discussing time, in one form or other, is something that is discussed regularly. For this child, time was given prominence, probably because her continual late arrival at school meant that she and her family were not meeting societal expectations. For other children, it may be different circumstances that affect what measurement attribute is given prominence. Also for this child, interactions around measurable attributes were connected to actions. Schools need to talk with their students' families to find out whether measurement is connected to action in their homes so that teachers can take this into consideration when designing their teaching programmes.

For this child, there were many interactions that discussed the relationship between different units of time. If this is also the case for other children, this may provide a better context for introducing formal units than the more common one of length.

The data from this research suggest that home measurement practices cannot be taken for granted but instead must be investigated further. This will allow for greater discussions between families and teachers in which the school may better learn how to make use of the mathematical experiences that children have had at home.

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REFERENCES

Benigno, J.P., & Ellis, S. (2008). Do parents count? The socialisation of children's numeracy. In O.N. Saracho & B. Spodek (Eds.), *Contemporary perspectives on mathematics in early childhood education* (pp.291-308). Charlotte, NC: Information Age Publishing.

Blevins-Knabe, B., & Musun-Miller, L. (1996). Number use at home by children and their parents and its relationship to early mathematical performance. *Early Development and Parenting*, 5 (1), 35-45.

Bottle, G. (1999). A study of children's mathematical experiences in the home. *Early Years*, 20 (1), 53-64.

Buys, K., & de Moor, E. (2008) Domain Description Measurement. In M. van den Heuvel-Panhuizen & K. Buys (Eds.) *Young children Learn Measurement and Geometry* (pp.15-36). Rotterdam: Sense Publishers.

Clarke, B., & Robbins, J. (2004). Numeracy enacted: Preschool families conceptions of their children's engagements with numeracy. In I. Putt, R. Faragher & M. McLean (Eds.), *Mathematics Education for the Third Millennium: Towards 2010* (Proceedings of the 27th Annual Conference of the Mathematics Education Research Group of Australasia, pp. 175-182). Sydney: MERGA.

Clemson, D., & Clemson, W. (1994). *Mathematics in the early years*. London: Routledge.

Dougherty, B. (2003). Voyaging from theory to practice in teaching and learning: A view from Hawai'i. In N. A. Pateman, B. Dougherty & J. Zilliox (Eds.), *Proceedings of the International Group for the Psychology of Mathematics Education* (Vol. 1, pp. 17-31). Honolulu: PME.

Gifford, S. (2004). A new mathematics pedagogy for the early years: In search of principles for practice. *International Journal of Early Years Education*, 12(2), 99-115.

Meaney, T. (2008). Authority relations in the acquisition of the mathematical register at home and at school. In D. Pitta-Pantazi & G. Philippou (Eds.) *European Research in Mathematics Education V* (pp. 1130-1139). Lanaca, Cyprus: ESRME. Available at: http://ermeweb.free.fr/CERME5b/

New Zealand Ministry of Education. (2007). *Book 9: Teaching number through measurement, geometry, algebra and statistics*. Wellington: Author.

Street, B. V., Baker, D., & Tomlin, A. (2005). *Navigating numeracies: Home/school numeracy practices*. London: Kluwer.

Vandermaas-Peeler, M. (2008). Parental guidance of numeracy development in early childhood. In O.N. Saracho & B. Spodek (Eds.), *Contemporary perspectives on mathematics in early childhood education* (pp.277-290). Charlotte, NC: Information Age Publishing.