

Symposium: Research Methods Involving Children's Drawings in Mathematical Contexts

In this symposium we present and discuss some methodological issues and possible solutions that have been encountered during our research into children's mathematical thinking, behaviours and affective responses, as reflected, at least in part, through their drawings. It has been claimed that, "Drawing can be a window into the mind of a child" (Wolek, 2001, p. 215). Such a statement implies that a child's self-created drawing can provide an indication of his/her internalised mathematical perceptions and conceptions. Note that the word 'drawing' can be used as either a noun or a verb, and hence can refer to either a completed artefact or to the dynamic act of creation. Depending on the aims, theoretical perspective and context of the study, researchers may focus on one form of 'drawing' or explore both forms.

Although drawing has long been an expected component of children's mathematical activity, rigorous research methods utilising mathematical drawings have remained somewhat underdeveloped. In recent years, a number of researchers have grappled with the design and development of specific aspects of methodology in their separate projects. With few established research methods for guidance, researchers have been creating and refining task designs, interview protocols, data capturing strategies, analysis techniques and interpretation processes for their studies of children's mathematical drawing. Each of the symposium papers presents a different research tool or technique that has been developed within its own unique context, with the purpose of stimulating discussion and advancing the development of effective research methods in the field of children's mathematical drawing.

Wolek, K. (2001). Listen to their pictures: An investigation of children's mathematical drawings. In Cuoco, A. (Ed.), *The roles of representations in school mathematics*, NCTM 2001 Yearbook, (pp. 215-227). Reston VA: NCTM.

Chair/Discussant: Joanne Mulligan

Paper 1: Amy MacDonald & Steven Murphy *Using the drawing-telling approach to reveal young children's mathematical knowledge.*

Paper 2: Jennifer Way & Jennifer Thom. *Capturing the mathematical drawing process using a digital pen.*

Paper 3: Kate Quane, Mohan Chinnappan & Sven Trenholm. *The nature of young children's attitudes towards Mathematics.*

Paper 4: Jill Cheeseman & Andrea McDonough. *Coding young learners' pictorial responses to an open-ended assessment task.*

Using the Drawing-telling Approach to Reveal Young Children's Mathematical Knowledge

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This paper contributes to the symposium, '*Research methods involving children's drawings in mathematical contexts*' by exploring the "drawing-telling" approach to researching with young children. "Drawing-telling" is a methodological approach that encourages young children to represent their experiences and understandings through both drawings and accompanying narratives. The authors have used the drawing-telling approach to elicit young children's understandings about measurement within their first few weeks of starting primary school. This paper details the drawing-telling approach, and shares some insights and examples from the larger study of children's measurement knowledge at the start of school.

The "Drawing-telling" Approach

For many years, early childhood researchers have advocated for the use of drawings in researching with children. Research methodologies based on children's drawings are seen to attend to the communication strengths of young children (Wright, 2012), and empower children in the research process (Einarsdóttir, 2005). Children's drawings have been utilised by mathematics education researchers as a means of, for example, accessing children's mathematical knowledge (Lehrer, Jacobson, Kemeny, & Strom, 1999), investigating children's problem-solving strategies (Abu Bakar, Way, & Bobis, 2016), and exploring how children make "mathematical marks" (Carruthers & Worthington, 2006).

This paper reports on a drawings-based methodology known as the "drawing-telling approach". It was noted by van Oers (1997) that children often provide speech utterances when drawing as an attempt to ensure that all elements of the drawing are communicated. The notion of combining "drawing" with "telling" (a specific prompt to describe the drawing) has been explained by Wright (2007) as a process of seeking clarification from the child, as well as an extension of the child's images and stories. The use of both drawing and telling offers "an authentic kind of participation for the child" (Wright, 2012, p. 19) and ability for children to "bring to the surface what [they] already know, what they are grappling with and what they are motivated to explore further" (Wright, 2012, p. 214). Moreover, the "telling" component adds valuable information to the drawing because children's images can be selective, and on their own, tell an incomplete story (Einarsdóttir, 2005).

The drawing-telling approach has been adapted by Smith and MacDonald (2009), who encouraged young children to draw, and talk about, clocks as a means of discovering the knowledge about time possessed by young children upon entry to primary school. Smith and MacDonald highlighted the potential of drawing-telling as an open-ended task for finding out young children's mathematical knowledge. They noted the multimodality of drawing-telling as a particular strength of the methodology, as it provided children with the opportunity to "reveal their understandings in different but complementary ways" (p. 23).

This paper draws on data from a larger study carried out with 97 children who had just commenced primary school in NSW. As described in detail elsewhere (MacDonald, 2013), the study utilised six drawing-telling tasks to ascertain these children's experiences with, and understandings of, measurement concepts and processes as they commenced school. The children were invited to draw in response to a specific measurement-focused prompt (e.g. "Draw something tall and something short"), and while drawing, were encouraged to

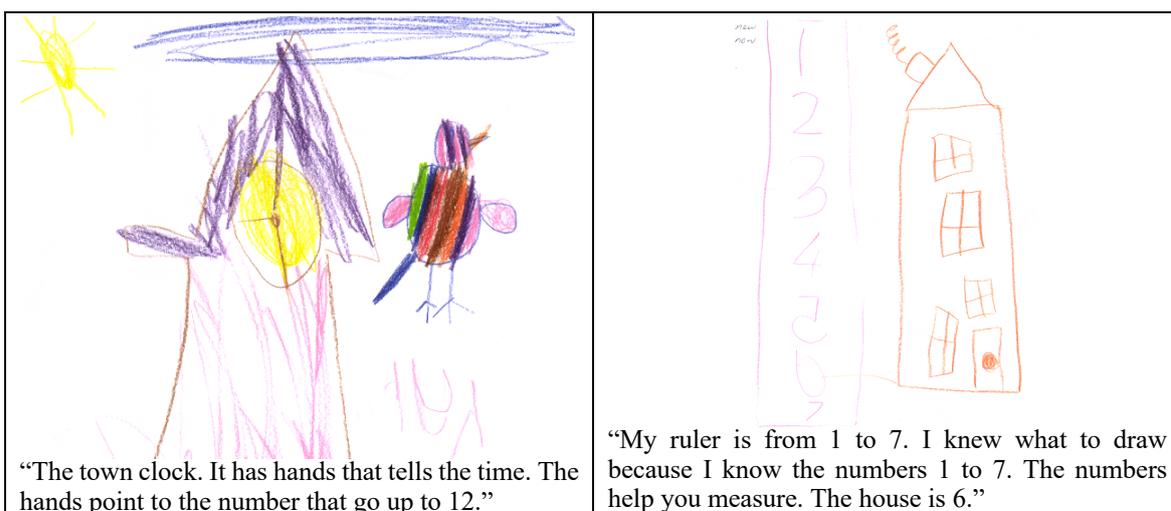
describe their drawing to the researcher. The children’s comments were annotated on the drawing so that both the drawing and the children’s narrative could be considered as a whole.

Insights and Illustrations

In this paper, we utilise data from two of the tasks from the larger study: 1. “Draw a ruler”; and 2. “Draw a clock”. We have chosen to share these two tasks here because, in addition to offering insights into children’s knowledge about measurement *concepts*, they reveal understandings about measurement *processes and tools*, as well as *structural* knowledge associated with partitioning and units. We offer a selection of examples that illustrate the contributions of the drawing-telling approach to a study of young children’s mathematical understandings. Full analyses of these tasks are reported elsewhere (MacDonald & Murphy, 2018; MacDonald & Murphy, under review).

Revealing the Full Picture of Children’s Knowledge

Drawing-telling allows children to offer a more complete picture of their understanding of measurement than a drawing alone. The clock drawn by Kyra (Figure 1) included only a round face and hands, whereas what she told indicated what she knew of the numbers of a clock and their relationship to the hands. Ella’s ruler picture (Figure 2) shows number sequence and partitioning, but it is her narrative that reveals she has deliberately drawn a measurement of the house.



Revealing the Potential for Misinterpretation

Not only does limiting analysis to a child’s drawings risk building an incomplete picture of their understanding, it may also lead to incorrect conclusions about a child’s knowledge. Wayne’s drawing (Figure 3) without his telling indicates only a rudimentary understanding of clock structure. However, his narrative exposes an awareness of the role of numbers and time-telling. Similarly, on first inspection of Tye’s ruler drawing (Figure 4), it might be thought Tye knows little about rulers; however, his narrative suggests he has significant knowledge of ruler structure.

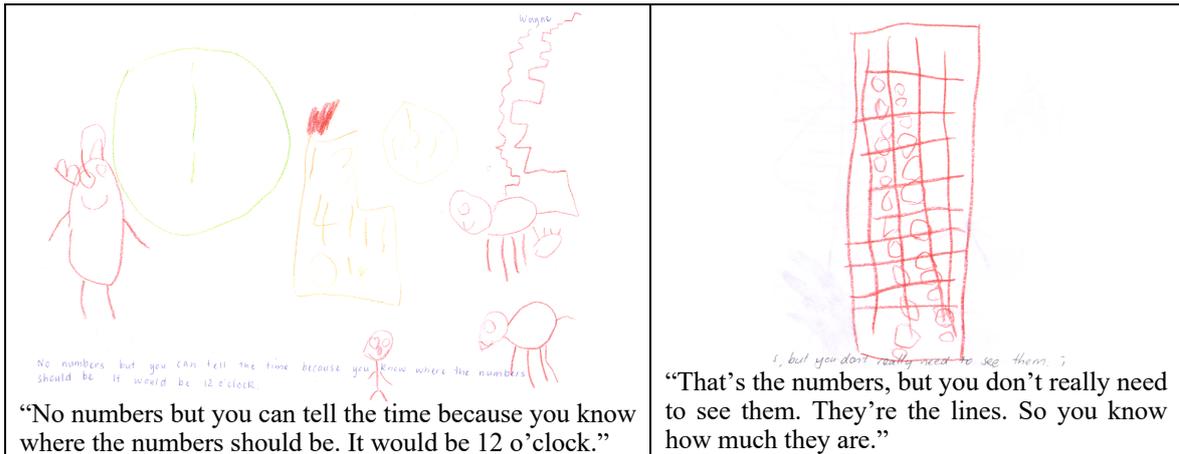


Figure 3. Wayne’s clock.

Figure 4. Tye’s ruler.

Revealing how Experiences Shape Understandings

Drawing-telling offers insights into how children gained the understanding they display in their drawings. Makaylee drew a clock with differentiated hands and some numbers (Figure 5), and explained that she had been practicing with her dad. While it may not be clear what some of the objects in Willis’ drawing are (Figure 6), his rich narrative offers insight into his understanding of ruler structure and application.

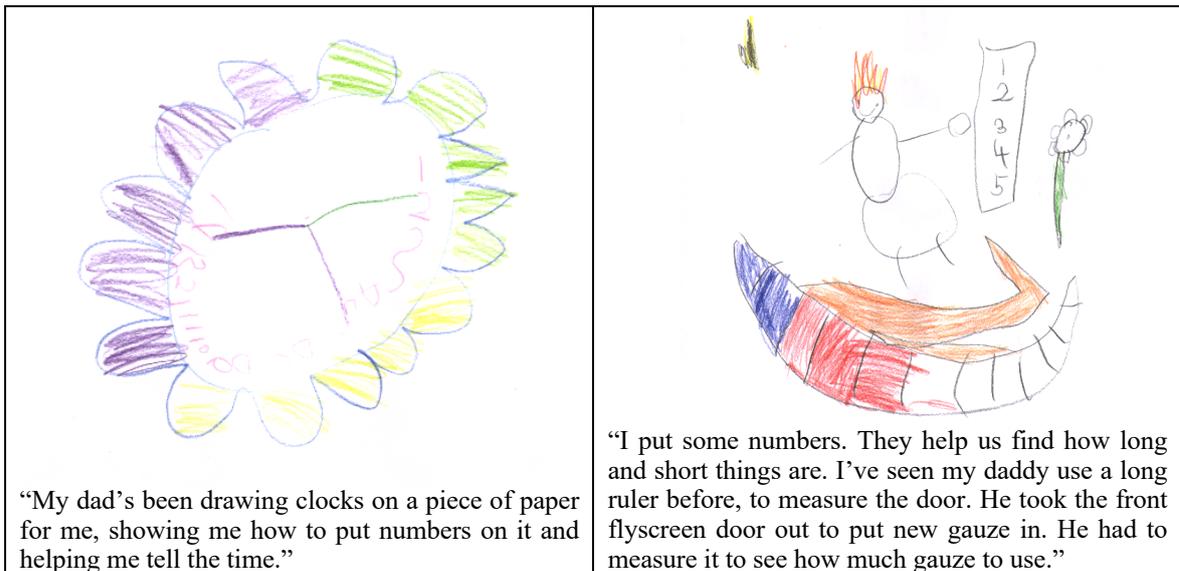


Figure 5. Makaylee’s clock.

Figure 6. Willis’ ruler.

Revealing the Utilitarian Value of Measurement

Finally, drawing-telling makes it possible for a child to share what they understand of the purpose of measurement. Phoebe used the invitation to describe her clock drawing (Figure 7) to explain that clocks help regulate aspects of her daily routine. Ethan used the invitation to discuss his ruler drawing (Figure 8) to reflect on the appropriateness of different measuring devices for different purposes.

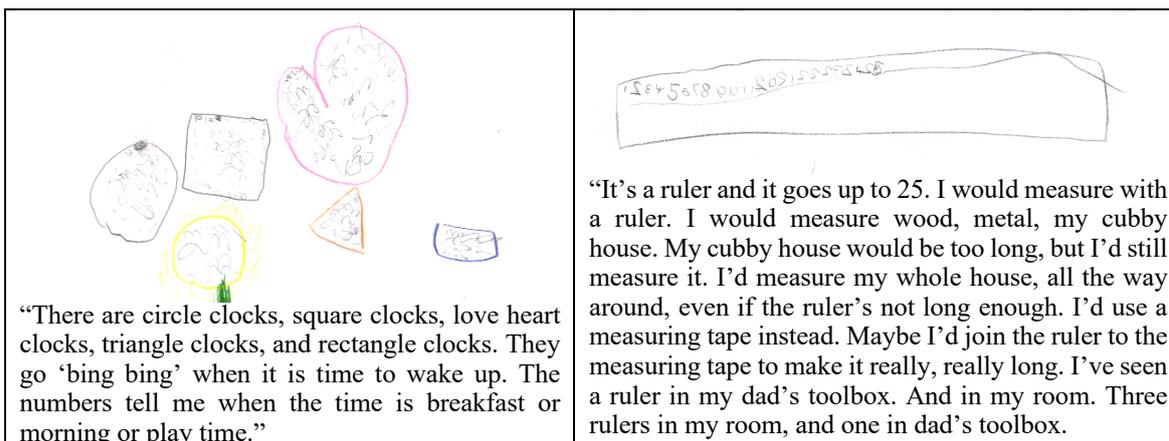


Figure 7. Phoebe’s clock.

Figure 8. Ethan’s ruler.

Implications

As explained by Smith and MacDonald (2009), drawing-telling is a powerful tool for finding out the background knowledge and experiences of children before beginning formal instruction on a mathematical topic. It extends on the power of using drawings to explore the mathematical knowledge of young children, improving the accuracy and richness of the interpretations that can be made. Indeed, the ability to clarify information through describing the drawing enables children to ensure their knowledge has been recognised. For researchers, it offers the potential to explore not just what a child knows but also how the child knows it and why this knowledge is significant to them. For educators, drawing telling allows deeper insight into a child’s mathematical understanding and provides the potential to personalise learning and connect prior learning to future learning experiences.

References

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