Australian Indigenous Students: The Role of Oral Language and Representations in the Negotiation of Mathematical Understanding

Elizabeth Warren
Australian Catholic University
<E.Warren@mcauley.acu.edu.au>

Janelle Young
Australian Catholic University
<J.Young@mcauley.acu.edu.au>

Eva deVries
Independent Schools Queensland

This paper reports on a small pilot study conducted in an Indigenous P-13 school in North Queensland. This pilot study occurred over a two day period with the specific aim of exploring the role of oral language and representations in negotiating mathematical understanding. Implications are drawn for the implementation of a large study, commencing in 2007 with 4-year-old Indigenous students as they transition from home to school. All students in this context either speak Aboriginal English or Creole as their first language. The pilot study occurred in two classrooms, one with 15 Year 6/7 students and the other with fourteen Years 4/5/6 students. The preliminary results indicate that explicit consideration needs to be given to the development of precise mathematical language, strategies for linking school mathematics to home environments, the use of questioning in establishing classroom discourse, and the recognition that many of these classrooms are bilingual.

Introduction

This paper reports on a small pilot study that occurred at the commencement of a new project to be conducted in four schools in North Queensland. The main project, a longitudinal study, aims to explore the role that oral language and representations play in assisting Indigenous students reach an understanding of white mathematics, with a particular focus on Prep students as they transition into school from home. One of the schools, an Indigenous school has 465 students, with nearly all the students being either Indigenous Australians or from the Torres Strait Islands. The pilot study was conducted with older students and their teachers in this school with a specific aim of exploring oral language, representations and understanding mathematical concepts, drawing initial implications for the main project.

Many researchers have found there is a mismatch of conditions for learning for young Indigenous Australian children as they enter school (Bliss, 2004; Dunn, 1999; Simpson & Clancy, 2005; Simpson, Munns, & Clancy, 1999; Zevenbergen, 2000). Tension still exists between policy and suggested strategies for Indigenous students. The reality of responding to cultural differences and practices and adjusting the interactions and strategies for teaching and learning in classrooms is still far from ideal (Simpson & Clancy, 2005). The use of spoken language in school and the types of interactions teachers utilize can either advantage or disadvantage Indigenous Australian students. Furthermore, the importance of spoken language as the foundation for all learning is often not fully recognized and many young Indigenous Australian children are not able to make a strong start in the early years of schooling as the discourses of the family often do not match that of the school (Cairney, 2003). This mismatch of home and school language has been shown to disadvantage Indigenous students' achievements in literacy and numeracy in the long term (Dickinson, McCabe, & Essex, 2006; MCEETYA, 2004). Understanding and accepting

Aboriginal English (AE) as a dialect of spoken English used by most Aboriginal and Torres Strait Islander people is vital and knowing that there are variations across particular communities is important (Haig, Konisberg, & Collard, 2005). While Standard Australian English (SAE) is the discourse of the school, and it is conjectured that teachers need to create a bridge for young Indigenous students between AE and SAE as they grapple with both the new language and new concepts little is known about what this means in practice.

Patterns of classroom interactions have been shown to disadvantage some students particularly the interaction of teacher questioning as Indigenous students do not commonly experience this type of interaction at home or within their community (Galloway, 2003; Haig, Konisberg, & Collard, 2005). Unjustified blame has been placed upon Indigenous students in the past and absenteeism, disadvantaged social background and culture have all been viewed as contributing factors (Bourke & Rigby, 2000). This is seen as irresponsible (Cooper, Baturo, Doig, & Warren, 2004). Insufficient consideration has been given to the complexities that confront young Indigenous students as they enter school. Educators have not lifted the blame and given sufficient positive consideration to ways of adapting the conditions for learning for these students to prepare them for success rather than failure. Thus the dominant view of society in blaming aspects of culture, disadvantage and maintaining low expectations needs to be turned around so that a positive framework can be adopted in order to improve the educational outcomes for Indigenous Australian students (Matthews, Howard, & Perry, 2003; Sarra, 2003).

Theoretical Frameworks

Various broad theoretical fields are relevant in addressing the issues related to this research, for example, situated cognition (Kirshner & Whitson, 1997; Lave & Wenger, 1991; Watson, 1998), and cultural models (Holland & Quinn, 1987). As the focus of this pilot study was on two particular aspects of classroom interactions, namely, oral language and mathematical representations, the frameworks chosen in this initial study reflect these dimensions. The initial lenses chosen to view the classroom discourse were Duval's representations and Peirce's semiotics.

Duval (2002) argues that mathematics comprehension results from the coordination of at least two representational forms or *registers*; the multifunctional registers of *natural language*, and *figures/diagrams*, and the mono-functional registers of *notation systems* (symbols) and *graphs*. He contends that learning involves moving from *treatments* where students stay within one register (e.g., carrying out calculations while remaining strictly in the one notation system) to *conversions* where students change register without changing the objects being donated (e.g., passing from natural language of a relationship to using letters to represent it) and finally to *coordination* of registers. He argues that learning also requires building understanding of the mathematical processing performed in each register (Duval, 1999). One theory relating to communication in the classroom is semiotics.

The epistemological stance taken in this analysis is the science of semiotics; a means of addressing signs, their connections and meanings. In this instance signs refer to external representations. Presmeg (1997) suggests that when one recognizes the structure of the system he or she engages in, explains this structure to others by such means as encoding it in a diagram or applying some overarching framework, then mathematics exists. So while semiotics is commonly used to construct links between cultural and historical practices and mathematics (Presmeg, 1997; Radford, 1997) it also assists us to understand classroom discourse in mathematics (Saenz-Ludlow, 2001; Warren, 2003). Sign interpretation is a personal process with some students being unable to move beyond the physical

characteristics of the sign (the external representation). Peirce (1960) believes that the sign relation is inherently triadic, linking an object, a representation and an interpretation so that the object determines the representation and in turn determines the interpretation. Semiosis involves the process of going beyond particular signs to more and more complex representations incorporating new signs and generalizations (Peirce, 1960); an evolving process. Vygotsky regarded signs as tools that were capable of influencing one's inward behaviour and the behaviour of another. Thus the teaching and learning process can be seen as a process of semiosis where the teacher and students become both contributors and interpreters.

Methods

Participants

This paper reports on how students and teachers use the language of mathematics and representations in their mathematical learning. The school chosen for this study is a P-13 school; a large boarding school catering exclusively for Indigenous and Torres Strait students. This school prides itself in offering quality education for Indigenous students in far north Queensland. In 2006 47% of Year 3 students, 69% of Year 5 students, and 17% of Year 7 students achieved above the national benchmark for numeracy. In addition, approximately 30 students successfully completed Year 12. Two teachers, David and Melissa, volunteered to participate in this pilot study. David teaches 15 Year 6/7 students whose ages range from 10 years to 12 years with eight being Australian Indigenous, 6 from Torres Strait and 1 from Papua New Guinea. Melisa's class consisted of 14 Year 3/4/5 students, with eight being Australian Indigenous and six of Torres Strait Island origin. Both of these teachers had been working in these types of environments for up to 5 years and were perceived by both the school community and local educational consultants as exemplary teachers of Indigenous students.

Data Sources and Analysis

The data was gathered from three main sources, namely, (a) open ended interviews with the two teachers before the teaching began (Pre Interview), (b) videotapes of two lessons especially constructed by the teachers to illustrate the adaptations they made to their teaching in these environments when teaching mathematics, and (c) a reflective interview with each teacher at the end of the teaching episode (Post Interview). All lessons were videotaped and field notes were taken. At the completion of the lessons, the researcher and teacher reflected on the researcher's field notes, endeavouring to minimise the distortions inherent in this form of data collection, and arrive at some common perspective of the instruction that occurred and the thinking exhibited by the students participating in the classroom discussions. The video-tapes were transcribed. The videos and participant observation scripts served to provide insights to the learning of the community and particularly identifying specific actions, specific use of representations and conversations that supported this learning.

Results and Discussion

Pre-interview

Both teachers commented on the difficulties they experienced on a day to day basis in these environments. These related to the language difficulties that they experienced, the need to relate all their examples to relevant real world contexts, the use of a variety of visual aides needed to allow access to the ideas, and the tension between what they perceived as "talking about mathematics in Australian Indigenous English" and precise mathematical language, for example, using "big" and "big up" for tall and taller, and the need to ensure that Indigenous Australian children had the opportunity to communicate in "proper mathematical language". This last issue relates to a notion of empowerment. They believed that "setting the benchmarks" too low was in fact an act of "keeping Indigenous Australians in their own class, denying them the opportunity to move out of their low socioeconomic circumstances and act as "activists for real social change". Both presented two lessons that they believed exhibited these characteristics. They perceived that teaching in these classrooms required a high use of oral language, hands on experiences, a range of representations and an ability to continually adapt the learning trajectory to maximise access of the participants to the mathematical concepts. The data reported in this paper is one excerpt from the Year 3/4/5 classroom and one short excerpt chosen from the Year 6/7 classroom. The first illustrates the use of different representations and contexts to assist students solve a problem involving comparing the heights of two children, and the second illustrates students "code switching" as they engage in an activity involving calculating volumes of a variety of shapes made from blocks. Figure 1 illustrates the particular representations utilised by Melissa as she discussed the problem with the students.

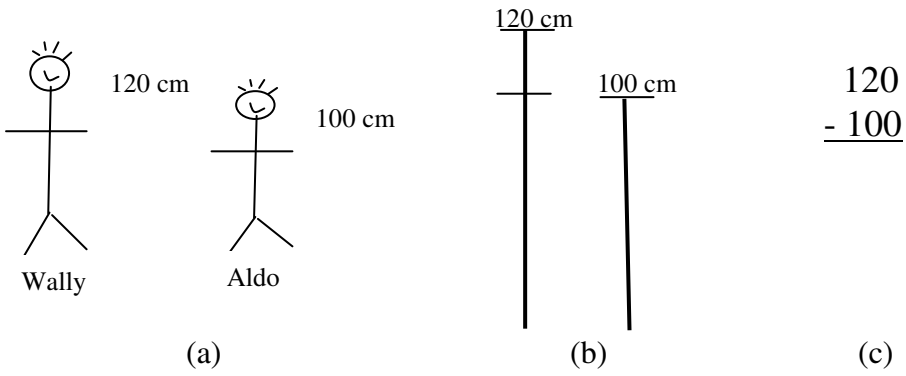

Figure 1. Diagrams drawn on the board at different stages during the discussion.

Excerpts from the Year 3/4/5 Classroom (Melissa's Classroom)

T:	Wally was 120 cm tall. (Both Wally and Ado are children in the class).
Children:	OOOHH.
T:	Here is Wally. Now Ado, he's a little bit younger so he is a little bit shorter. Ado was 100 cm tall. [Draws Figure 1 (a) on the Board] How much taller, listen carefully to the question. How much taller was Wally than Ado? How much taller was he than Ado? Think about it very very carefully. How much taller? [Paused]

T: We sometimes say what is the difference between them.
C1: 220cm.
T: That would be if he jumped up on his head.
[Gesturing the action of one jumping up on top of the other]
T: That how much they would be altogether. How much taller?
T: Here is 100cm which might be about here. [Marking off in the air 100cm with her left hand]
T: Wally is 120cm tall which might be about here. How much taller? [Gesturing 120 cm as a point above 100 cm and using both hands to focus their attention on the gap].
T: What is that difference between 100 and 120cm. What is that difference in there?
[Moving both hands backwards and forwards to emphasis the focus is on the gap between the two hands] Do you know?
C2: It could be 100 and something.
T: No that is an excellent go though. What is the difference between 100 and 120? What is that difference in there? How much is it Do you know Marley?
T: Lets look at this way. We have 120 cm is up here and 100cm is to here?
[Draws Figure 1 (b) on the board].
What is that difference in there? This is 100cm. What is the difference in between there?
[Pointing the difference between the two heights].
T: What is the difference in there? How many marks are between there?
C3: 50
T: No it's not 50.
C4: 100
T: No it is not 100. Think about it carefully. How many points go in between there and there. Very, very tricky. Think it about carefully.
C4: 10
C5: .8
C6: [shouted out] Miss 20
T: This is an easy way of doing this. We can do the difference between something by doing a take away. 120 take away 100
C7: 2
C8: 200
T: Lets think of it this way if you had 120 dollars and you took away 100 dollars how much is left. 120 dollars and you gave away 100. How much is left?
[Gestures with her closed fists the action of take away and then draws Figure 1 (c) on the board].
C9: 120
At this stage nearly all the class were whispering 20.
Children in unison: 20
Melissa then worked through the algorithm with them.

From a semiotic perspective the *object* is considered to be the beginning task, namely, "If Wally is 120 cm tall and Ado is 100 cm tall, how much taller is Wally than Ado" and the *signs* are the various representations that assisted in understanding the object. The *interpreters* were the students themselves. Melissa continually adjusted her representations as a response to students/ interpretations. The first representation (Figure 1(a)) did not seem to be interpreted by students as a difference representation, hence the introduction of the gesture, showing that the focus was on the difference between the children's two heights. This was further represented as a diagram with horizontal bars used to again focus attention on the difference (see Figure 1(b)). As Melissa proceeded along this trajectory she also changed the object itself from a comparison problem to a subtraction problem (by introducing the language of difference and then take away). Finally, she switched into the context of money thus the original object changed from *how much taller is Wally than Ado* to *if you had 120 dollars and gave away 100 dollars how much is left.* This process illustrates a common strategy used in many Indigenous classrooms, the context of money as a bridge to understanding mathematics. While the students successfully answered this

problem, does this assist them in reaching an understanding of the original problems and do they see the analogy between each? This needs further research. Also another common characteristic of this conversation was the lack of ongoing dialogue about the problem itself. The students volunteered answers (which were often incorrect) but there was no ongoing conversation about their thinking. One concern that these teachers had was the "shame factor". Melissa was aware that Indigenous students do not like being asked questions in front of the whole class, and especially did not like their incorrect answers to be pursued, hence her continual positive reinforcing comments, such as, "good try" as the lesson proceeded. In some instances it appears that students are unable to go beyond the written mark; the literal interpretation.

The inherent triadic nature of sign relations (object, representations and interpretation) are exhibited in this research. The tasks presented in this research induce an interaction between these three dimensions but in this instance whether the interplay between different signs and their interpretations bring deeper meaning to the object itself is the key question. The use of gesturing was also explicit throughout the lesson. In fact the role of gesturing within a culture with a strong oral history, may in fact prove to be an important representation in the interpretation process. Recent research has evidenced that children are significantly more likely to reiterate the teacher's spoken strategy when it is produced in conjunction with gestures that conveyed the same strategy than when it is produced with no gestures at all (Goldin-Meadow, 2006).

From Duval's perspective, most of this lesson occurred within the mono-functional register, the use of language and diagrams to represent the problem at hand. This is considered to be an easier process than crossing across registers. While this framework indicated that the lesson was situated in a register which was considered to be "cognitively easier" the register gives little insight into how to work effectively within each or the role of gestures in creating meaning. This requires further research.

Excerpt from the Year 6/7 Classroom

The second expert was chosen for inclusion in this paper as it demonstrates students "code switching" as they interacted in the classroom context. The lesson began with a general discussion about what we mean by the term volume, how it differs from capacity, and the processes commonly used to calculate the volume of a three-dimensional cuboid. The students were then split into three rotational groups. The following except is from a conversation between an Australian Indigenous student and a Torres Strait Islander student.

C1:	(Singing out loud in own language)
C2:	You killed it
C1:	You starting dissing each other
C2:	You were going to start dissing, then they're going to start dissing and then your going to diss them
C1:	Hello, Miss where are you from?
R:	I am from Brisbane and where are you from?
C1:	No, I'm from, I'm born in Rockhampton but I rear up in Yarrabah
C2:	How many are there? [referring to the diagram of cubes]
C1:	Twenty-four, yes that's right. 1, 2, 3, 4, 5, 6, 7, is that seven? Yep, it's seven. Twenty-four and I still need to do this one. [counting up the cubes in the diagram]

This short extract illustrates a typical conversation that occurred in the classroom. As the students worked and conversed with each other they continually switched between their own languages, but when it came to discussing mathematical concepts they expressed their

ideas using the language of mathematics. It is conjectured that a possible reason for this is that their own language lacks the specific vocabulary needed to describe these mathematical situations.

Post Interview

The reflections at the end of the lessons between the teachers and the researcher focused on four broad themes, all of which impact on our main study. First, there are tensions between all the languages that exist in these situations and the need to pave the way to high levels of achievements in mathematics. There were at least two different languages in these classrooms, Australian Indigenous English and Creole. Both teachers, while they knew something about these languages felt that both languages lacked aspects that assisted them in working in a mathematical environment. For example, there appeared to be little attribute language in their home language. For length the predominant comparative words were "big", "bigger up", "small", and "boney". Hence, they felt a need to ensure that their lessons provided opportunities for Indigenous students to learn about and use the explicit language of mathematics. Second, there are culturally different styles in communication between home situations and school situations, especially when it came to direct questioning. Past research has evidenced that if an Indigenous student cannot answer the question then they experience a feeling of "shame", especially if they are singled out in front of others. Hence in both instances classroom discourse tended to avoid probing "incorrect thinking". Third, Indigenous students' engagement increases if the examples are related to their world and the approach is very hands on. Melissa commented that she always endeavoured to use the students themselves as the context she used when discussing mathematical ideas, hence the choice of Wally and Aldo for her comparative measurement problem. Fourth, given that their culture's communication is based on oral language there is a reluctance to "write" things down. All of these impacted on how both teachers conducted their lessons.

Summary and Implications

This pilot study begins to tease out particular issues that need to be taken into consideration as young Indigenous students move from a home environment to a school environment. The first implication for the main project is the need to explicitly link home environment to school environment, with the specific aim of allowing young Indigenous students access to white mathematics. The theoretical frameworks provided for this analysis give some insights into the classroom discourse. In the case of Melissa's class semiosis assisted in viewing the classroom interchange as consisting of three main dimensions, namely, object, representations, and interpretations. It also assisted in documenting how she changed the representations to assist the students reach some meaning about the object. But in this instance it was a backward mapping, starting with school and working back to home and the context of money. For the main project a more appropriate framework could be the notion of semiotic chaining, a means of building links between cultural practices and the teaching and learning of mathematics in school (Presmeg, 2005), an example of which was given by Walkerdine (1988) in her seminal work on mother – daughter relationships in the home environment. Semiotic chaining exemplifies the notion of layering to abstraction where the object and sign relationship build from the concrete to the abstract by the sign itself taking on the role of the "new

object" for each subsequent layer (Presmeg, 2005). In this instance the initial object is situated in the home environment (e.g., guests coming to visit) and the final object is in the school environment (e.g., whole number). The impact of this framework on Indigenous learning needs further investigation.

The second implication is the recognition that Indigenous classrooms are bilingual and their home language, while sounding like English is in fact different from Australian Standard English. The two instances reported in this paper show that in their home language there is a lack of the vocabulary commonly used to describe mathematical situations (e.g., the lack of attribute language and the need to switch to mathematical code when describing mathematical situations). While this has been recognised as a problem in past research, there is a paucity of research focusing on the development of mathematical language with Indigenous students and its impact on mathematical achievement.

The third issue relates to the type of classroom discourse and choice of representations used to explore mathematical concepts. In particular, what style of discourse encourages students to engage in classroom discussions about mathematics concepts? How do we walk between the idea of justification and cultural notion of shame? What role do gestures have in supporting a culture based on an oral language tradition?

Although there is some recognition that many Indigenous students have English as a second language, their educational outcomes indicate there is still room for improvement. It is well recognised that oral communication is dominant in the lives of these students and that their experience with print and other literacies is often limited. By building on the oral language strengths of young Indigenous Australian students, the main study seeks to bridge the gap between home and school and assist students to enhance achievement in both literacy and numeracy. This pilot study reported in this paper begins to map the territory and provide indicators for the road ahead. As such, the research recognises the considerable capabilities of young Indigenous Australian students as they commence school and aims to assist them to engage in meaningful dialogue concerning literacy and numeracy in order to meet the challenge of improving long-term educational outcomes.

References

Bliss, J. (2004). Applying a cross-cultural framework to help Indigenous students learn to read and write. In B. Bartlett, F. Fryer & D. Roebuck (Eds.), *Conference Proceedings: Education: Weaving Research into Practice*, Volume 1, (pp.103-112). Retrieved May 9, 2006, from Informit database.

Bourke, P. C. J., & Rigby, K. (2000). *Better practice in school attendance: Improving the school attendance of indigenous students*. Canberra, ACT: DETYA.

Cairney, T. (2003). Literacy within family life. In N. Hall, J. Larson & J. Marsh (Eds.), *Handbook of early childhood literacy* (pp. 85-98). London: Sage Publications.

Cooper T., Baturo, A. Doig, S., & Warren E. (2004). Young white teachers' perceptions of mathematics learning of aboriginal and non-aboriginal students in remote communities. In M. Hoines & A. Fuglestad (Eds.), *Proceedings of the Twenty Eighth Conference of the International Group for the Psychology of Mathematics Education*, Volume 1, (pp. 239-246). Bergen: Bergen University College

Dickinson, D., McCabe, A., & Essex, M. J. (2006). A window of opportunity we must open to all: The case for preschool with high-quality support for language and literacy. In D. Dickinson & B. Neuman (Eds.), *Handbook of early literacy research*: (Volume 2, pp. 11-28). New York: The Guilford Press.

Dunn, M. (1999). Literacy development in an Aboriginal community summary of a research project: Literacy practices for diverse needs. *Australian Journal of Language and Literacy*, *22*(2), 103-119.

Duval, R. (1999). Representations, vision and visualization: Cognitive functions in mathematical thinking. Basic issues for learning. In F. Hitt & M. Santos (Eds.), *Proceeding of the Twenty first[t] Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education.* Volume 1, (pp. 3-26). Morelos, Mexico.

Duval, R. (2002). The cognitive analysis of problems of comprehension in the learning of mathematics. Paper presented at *the Semiotics Discussion Group: 25th annual conference of the International Group for the Psychology of Mathematics Education*. Norwich, UK: PME.

Galloway, A. (2003). Responding to responses: Interaction between Indigenous Australian students and their non-Indigenous teachers. In P. L. Jefferies (Ed.) *Joint Australian Association for Research in Education and New Zealand Association for Research in Education 2003 International Education Research Conference*, Auckland, NZ. Retrieved April 25, 2006, from: http://www.aare.edu.au/03pap/gal03580.pdf

Goldin-Meadow, S. (2006). Talking and thinking with our hands. *Current Directions in Psychological Science, 15,* 34 - 39.

Haig, Y., Konisberg, P., & Collard, G. (2005). Teaching students who speak Aboriginal English. *PEN 150,* 1-12.

Holland, D., & Quinn, N. (Eds.) (1987). *Cultural models in language and thought.* Cambridge, England: Cambridge University Press.

Kirshner, D., & Whitson, J. A., (Eds.) (1997). *Situated cognition: Social, Semiotic and psychological perspectives.* Mahwah, NJ: Lawrence Erlbaum.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* Cambridge, England: Cambridge University Press.

Matthews, S., Howard, P., & Perry, B. (2003). Working together to enhance Australian Aboriginal students' mathematics learning. In L. Bragg, C. Campbell, G. Herbert, & J. Mousley (Eds.). *Proceedings of the 26th annual conference of the Mathematics Education Research Group of Australasia*. Sydney: MERGA.

Ministerial Council on Education, Employment, Training, and Youth Affairs [MCEETYA] (2004). *Preliminary paper national benchmark results - Reading, writing and numeracy - Years 3, 5 and 7.* Retrieved May 1, 2005, from http://www.mceetya.edu.au/verve/_resources/ANR2004BmrksFinal.pdf

Peirce, C. S. (1960). *Collected papers*. Cambridge, Mass: Harvard University Press.

Presmeg, N. (2005). *The role of culture on the teaching and learning of mathematics.* Retrieved March 20 2007, from http://merg.umassd.edu/projects/symcog/bibliography/

Presmeg, N. C. (1997). A Semiotic Framework for Linking Cultural Practice and Classroom Mathematics. In J. Dossey, J. Swafford, M. Paramantie & A. Dossey (Eds.), *Proceedings of Nineteenth Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education,* Volume 1, (pp. 151-156). Columbus, Ohio: ERIC Clearinghouse for Science, Mathematics and Environmental Education.

Radford, L. (1997). On psychology, historical epistemology, and the teaching of mathematics: Towards a socio-cultural history of mathematics. *For the Learning of Mathematics, 17*(1), 26-33.

Saenz-Ludlow, A. (2001). Classroom mathematics discourse as an evolving interpreting game. In M. Anderson, A.Saenz-Ludlow, S.Zellweger & V.Cifarelli (Eds.), *Educational Perspectives on Mathematics as semiosis: From thinking to interpreting to knowing,* pp 253-284. Ottawa, Canada: Legas Press.

Sarra, C. (2003). Young and black and deadly: Strategies fro improving outcomes for Indigenous students. In Australian College of Educators, *Quality Teaching Series Practitioner Perspectives.* Retrieved May 12, 2006 from http://education.qld.gov.au/community/events/showcase/symposium/2005/pdf/chrissarra-conferencepaper.pdf

Simpson, L., & Clancy, S. (2005). Enhancing opportunities for Australian Aboriginal literacy learners in early childhood settings. *Childhood Education, 81*(6), 327-342.

Simpson, L., Munns, G., & Clancy, S. (1999). Language tracks: Aboriginal English and the classroom. *PEN 120*. Primary English Teaching Association.

Walkerdine, V. (1988). *The mastery of reason: Cognitive developments and the production of rationality.* New York: Routledge.

Warren, E. (2003). Language, arithmetic and young children's interpretations. *Focus on Learning Problems in Mathematics. 25*(4), 22-35.

Watson, A. (Ed.) (1998). *Situated cognition and learning of mathematics.* Oxford, England: University of Oxford Department of Educational Studies.

Zevenbergen, R. (2000). Language implications for numeracy: A study of language use of disadvantaged students. In *Improving numeracy learning*: What does the research tell us?. *Proceedings of the* Council for Educational Research conference 2000, Brisbane, October 15-17 (pp. 18-14). Retrieved June 1, 2007 from http://www.acer.edu.au/research_conferences/2000.html