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Supporting Teachers' Professional Learning at a Distance: A Model for Change in At-risk Contexts

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Abstract: This paper examines the effectiveness of a professional learning model developed to support early years teachers in rural and remote communities in Queensland as they began to implement the Australian Curriculum in Mathematics. The data are drawn from 35 teachers at the initial stage of a large, four year longitudinal study RoleM (Representations, oral language and engagement in Mathematics). The particular aims of the longitudinal study are to (a) identify effective pedagogical practices that may assist young Indigenous Australian students to negotiate Western mathematical understanding, and (b) investigate professional learning models that best support teachers within this context. The data was collected throughout the first year of the study. The findings indicate that as the year progressed participating teachers experienced significant and positive changes in: a) their attitudes, beliefs and pedagogical practices in relation to teaching mathematics; b)their expectations of student learning in mathematics; c) their confidence levels to be innovative, creative and experimental implementers of the new national mathematics curriculum; and d) their ongoing development from novice teacher to expert.

Introduction

Indigenous students nationally continue to experience the greatest educational disadvantage and exhibit the poorest learning outcomes (Biermann, 2008; Matthews, Howard & Perry, 2003). In the Queensland context, these students are often from culturally distinct rural and remote regions that are often staffed by inexperienced teachers (Heslop, 2011). For these teachers, who are unused to and/or ill-equipped to deal with the multifaceted challenges that exist in these contexts, improving students' learning outcomes remains difficult.
Given that staff turnover is usually high, mentorship unlikely and professional development opportunites difficult to access, teachers can feel ill-equipped to make a difference (Munns, Martin & Craven, 2008). However, teachers are the most critical *school-based* variable for improving student learning (Hattie, 2009). What and how they teach is important. (Smith and Gillespie, 2007; Villegas-Reimers, 2003; Timperely, 2008; Webster-Wright, 2009). Thus, changing how and what teachers in these contexts do in their classroom, is seen as critical (Matthews, Howard & Perry, 2003).

The Purpose of This Study

A strong connection between effective professional development, learning programs and improved student outcomes has been consistently demonstrated (Hattie, 2009; Smith & Gillespie, 2007; Timperely, 2008; Villegas-Reimers, 2003; Webster-Wright, 2009). Professional development has the capacity to shift teachers' beliefs and attitudes about themselves and their students. It assists in defining the goals teachers have for their students. This in turn influences their classroom practices (Borko & Putnam, 1995; Villegas-Reimers, 2003; Young, 2001). The purpose of this paper is to examine the effectiveness of a professional development model created to support early years' teachers in rural and remote Indigenous communities in Queensland as they began to implement the Australian Curriculum in Mathematics. These teachers are participants in a four-year longitudinal research project *Representation oral language and engagement in mathematics* (RoleM). This research project follows a large cohort of Indigenous students and their teachers from Foundation to Year 3. The aims of RoleM are to (a) investigate professional learning models that best support teachers within these contexts, and (b) identify effective pedagogical practices that assist young Australian Indigenous students to negotiate Western mathematical understanding.

The Context: Teaching in Remote Schools

Most teachers employed in remote and rural Indigenous communities experience difficulties (Lyons, Cooksey, Panizzon, Parnell & Pegg, 2006; MCEECDYA, 2010; Mills & Gale, 2003; Reid, 2011; Roberts, 2004).

The majority are beginning teachers who are at the start of their professional journey (Roberts, 2004; Sharplin, 2008). Major studies have revealed that very few feel prepared academically, culturally or professionally by their pre-service education to effectively teach Indigenous students (Lyons et al., 2006; MCEECDYA, 2010; Mills & Gale, 2003; Reid, 2011). In addition due to the high turnover of staff in these locations, there is often a paucity of experienced teachers who can act as mentors to these beginning teachers (Lyons et al., Panizzon & Pegg, 2007). Thus, the professional journeys of those beginning to teach can be fraught with obstacles with which their urban counterparts do not have to contend. While geographical and social isolation is a very difficult dimension for young urban trained teachers, professional isolation from a pedagogical perspective presents a number of significant challenges in terms of effectively engaging and teaching students in mathematics (Cresswell & Underwood, 2004; Lyons et al., 2006; Munns, Martin & Craven, 2008; Panizzon & Pegg, 2007).

Due to the constraints of the context, many teachers in remote and rural Indigenous schools are often unable to create highly effective instructional programs (Kent, 2004; Lyons et al., 2006). Ensuing behavioural problems and poor learning outcomes of their students are often seen as being beyond the teacher's control (Jones, 2009). A common pedagogical response can be a highly structured classroom, repetitive learning, a reliance on simple achievable worksheets, less time given to teaching and lowered expectations. (Hewitson, 2007; Munns et.al, 2008).

Theoretical Framework

The professional learning model developed for RoleM is concerned with creating professional learning experiences that support authentic and enduring changes for the way mathematics is taught to Indigenous students living in remote and rural regions. Thus, the theoretical framework that underpinned the model was derived from research related to the following two areas:

- Effective Professional Development Models
- Theories of Learning

Effective Professional Development Models: Supporting Authentic and Enduring Change

The effectiveness of professional development is defined according to measurable outcomes. These outcomes fall into three broad categories. The first pertains to the teachers' affective domain (Guskey, 2003). This hinges on the premise that if teachers enjoy the professional development session they are more likely to implement the ideas and activities in their classrooms (Salpeter, 2003). The second is associated with measurable gains in students' achievement (Kent, 2004). This is underpinned by the premise that implementation of the ideas presented at the professional development will result in greater learning outcomes for students. Hence, for professional development to be considered effective positive changes in students' outcomes should occur. Finally, effective development is seen as resulting in changed teacher behavior, especially in terms of their classroom practice (Wenglinsky, 2002). This is related to the finding that teachers' classroom practices and students' backgrounds have a similar effect on students' learning outcomes.

While there is a wide range of professional development models, this research drew from the two most commonly researched categories: *traditional* and *job-embedded* (Smith & Gillespie, 2007). *Traditional* PD is commonly seen as predominantly one-off workshops that occur in venues outside the classroom, while *job-embedded* PD is situated within the school/classroom context (Smith & Gillespie, 2007). Although each of these categories has a different emphasis, many features overlap, and these features were found to be useful in creating a professional learning model for this project.

Traditional professional development emphasises teacher knowledge; if teachers acquire the appropriate finite training episodes that focus on such things as 'make and take' workshops, curriculum and technology updates, and up skilling with the introduction of general knowledge skills and teaching competencies, students benefit. It is the most common form of PD and is predominantly structured around discrete new technologies (Gravani, 2007). These sessions are mostly perceived by teachers as being didactic and unrelated to classroom practicalities.

While research studies show that this narrow model of one-off discrete instruction sessions has very little impact on affecting teacher change (Gardner, 1996; Smith & Gillespie, 2007; Timperley, 2008), alternate studies show that this does not have to be the case if the following design elements are included: a) PD occurs over an extended period of time and incorporates follow up visits to teachers' classrooms. (Porter, Garet, Desimone, Birman & Yoon, 2000); b) Strong links are made between what is learned in PD and what happens in the classroom (Timperley, 2008); c) Subject matter knowledge is central to the PD focus (Garet, Porter, Desimone, Birman & Yoon, 2001); d) Emphasis is placed on personal learning, reflectiveness and program change, as opposed to individual change (Guskey, 1997); and, e) There is the inclusion of staff from the same school as studies show that teachers working

together is an effective strategy that supports teacher change (Porter et al., 2000). In addition, follow up visits by the deliverers of professional development are important as they have the potential to fashion teachers' beliefs about learners by allowing teachers to observe instructional strategies modelled in the classroom and to practice them with extensive support and feedback (Darling-Hammond, 1998; Elmore, 1996; Joyce & Showers, 1995).

Job-embedded professional development locates training within the school and classroom and allows teachers greater participation in shaping the content of instruction. As Shulman (2004) points out, teachers only become active learners when they become active investigators of their own teaching. The most significant changes in teacher beliefs and attitudes occur after teachers successfully implement a new practice and can see changes in the learning outcomes of their students (Guskey, 1988). Thus, for authentic teacher change to occur teachers need to (i) implement the new ideas presented at PD in their own classrooms, and (ii) evaluate their effect on their students' learning. In addition, collaboration with PD staff provides scaffolding and support from others to try innovative and creative pedagogical practices for teaching mathematics (Guskey, 1988).

Advocates of job-embedded PD models claim that professional development cannot be viewed as an isolated event, but should be an integral part of the daily work of teachers, administrators and all those who work within the school or system. The most important features that facilitate teacher change are opportunities for hands-on learning, content knowledge focus and alignment with other professional development activities and/or national/state/local education standards. Moreover, when professional development is embedded with longer and more intensive training efforts changes in teachers' beliefs and practices are more likely to be accomplishable (Garet *et al.,* 2001).

The model chosen for this research project not only encompassed aspects of both of these categories- Traditional and Job-embedded - but also drew on the literature relating to learning theories and in particular the Vygotskian social constructivist perspective of learning. It built on the successful Transformative Teaching in the Early Years Mathematics (TTEYM) model, a model specifically developed to support the implementation of patterns and algebra in the early years' classroom (Author, 2009). The model was grounded in theories relating to a community of practice (Lave & Wenger, 1991), a socio-constructivist perspective (Vygotsky, 1978) and effective models of professional development (Guskey, 1986).

Theories of Learning

In the Vygotskian social constructivist perspective of learning, the Zone of Proximal Development (ZPD) is defined as an individual's potential capacity for development through the assistance of a more knowing person (Vygotsky, 1978). The significance of ZPD is that it determines the lower and upper bounds of the zone within which PD instruction should be directed. Instruction is only efficacious when it goes beyond the notion of simply developing a person to acquire a particular set of skills or knowledge, to forcing learners to extend themselves through active engagement and investigation in various activities. It requires the 'more knowing person', or 'expert', to scaffold the tasks at hand as they guide the learner toward competent and accomplished practices that are transferable. A competent and accomplished practitioner will always be better equipped to independently implement innovative pedagogical practices across all curriculum areas after the 'expert' has withdrawn.

Professional learning (the learning that teachers undergo) is not atomistic, but rather a holistic experience that is 'dependent on an interaction among the learner, the context, and what

is learned' (Jarvis & Parker, as cited in Webster-Wright, 2011, p. 13). The nature and quality of that interaction also influences the depth and scope of learning as much as that of the learner's capability (Phillips, 2008; Wells, 1999). Therefore, our model of professional development involves much more than selecting and delivering discrete morsels of knowledge and assessing how correctly they have been implemented. It involves extended ongoing support and co-construction of knowledge within and beyond each learner's ZPD.

The RoleM PD Model

The RoleM PD model is based on the premise that in order to improve learning outcomes in mathematics for Indigenous students, teachers need to be supported within a socio-constructivist professional development model constructed on the principle that learning is cyclical. This consists of four distinct components: Knowing Person; Collaborative Planning; Collaborative Implementation; and Collaborative Sharing. It involves teachers in self-reflection as they trial approaches and resources in their classrooms to improve the quality of their teaching practice. This model was based on the view that teachers have the ability to improve their practice by trialling 'proven' effective learning experiences, and through continuous cycles of on-the-job reflections and discussions with experts from the field (Castle & Aichele, 1994). Figure 1 presents the key components of the RoleM (PD) model together with the key focus of each.

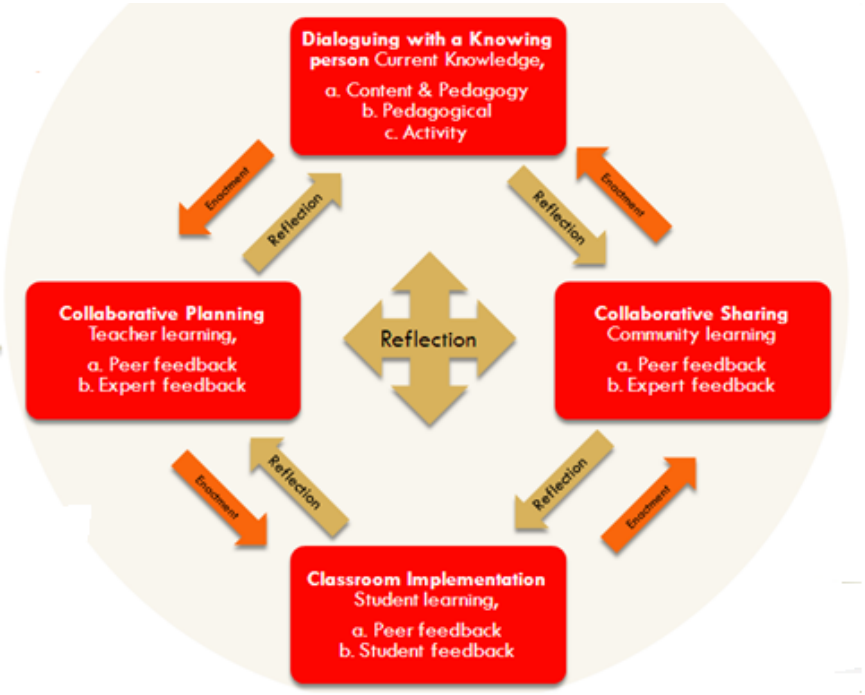

Figure 1. The RoleM Professional Learning Model.

Implementation of the Model Within These Contexts

Entry to each cycle began with the delivery of fully developed learning experiences. Throughout the year teachers were given a total of 35 fully developed learning experiences specifically designed for use with Indigenous students that were directly linked to the Australian

Mathematics Curriculum. These experiences reflected teaching strategies that are known to provide support for Indigenous students, and are as follows:

- provision of a gradual progression along a learning path, providing sufficient practice and ensuring that the student develops confidence in addition to the understanding of the concepts. This process can be described as: teachers' modelling the learning, followed by students working in small groups or with a partner to consolidate the learning, and finally students working alone to extend their own learning;
- exposure to a range of experiences and representations, not only those that the students find easiest or with which they are most familiar;
- group work of various types;
- integrated experiences that involve listening, reading, writing, recording, and speaking about concepts to enhance transference of skills;
- direct or explicit teaching; with the use of modelling and clear and explicit explanations of experiences and expectations;
- using a variety of representations simultaneously; and
- encouraging students to communicate about their mathematical learning.

(Frigo & Simpson, 1999; Warren & DeVries, 2009)

In addition, the chosen learning experiences were designed to cover most of outcomes delineated in the Australian Mathematics Curriculum, but not all. This choice was deliberate, as the aim was to provide teachers with a space to develop their own learning activities. By doing so, teachers could draw on learning gained from the RoleM (PD) model to develop and implement effective and appropriate learning activities suitable for their Indigenous students' particular cultural and community context. As Cochran-Smith (2004) suggests, very little learning occurs for teachers or students when lessons become a directed, scripted discourse and mastery of 'bits' of information becomes the goal. Teachers who are invited to use their classrooms as research sites, to co-construct knowledge and curriculum with their students, will be assisted to 'uncover and develop "theories of practice" or "theories in practice"' (Cochran-Smith, 2004, p. 48). Hence, it was perceived that this space would encourage teachers to move from implementing ideas and strategies provided by RoleM, to being accomplished teachers. Those who are accomplished possess a framework for thinking about their teaching and student learning, and altering and adjusting their practices, as necessary, throughout their careers.

Sample

The sample comprised 31 Prep and Year 1 teachers from 15 schools located in remote and very remote locations throughout Queensland. Participating schools were selected based on high Indigenous student enrolment, low SES school status, and high ESL needs. According to the Socio-Economic Indexes of Areas (SEIFA) (Australian Bureau of Statistics, 2006), these schools are situated in communities that are in the lowest decile for disadvantage and are considered to be seriously at risk educationally. This is demonstrated in the 2010 National Assessment Program Literacy and Numeracy (NAPLAN) testing results. The Year 3 mean in numeracy in these schools, for example, was 296, 80 points below the Queensland mean score and 100 below the National score for the Australian Year 3 student cohort. The teacher data reported in this paper was gathered over the first year of RoleM.

Instrument and Data Collection

A cycle of reflect, plan, implement, and evaluate was used by teachers during the project (Borko, 2004). Table 1 presents a summary of the phases together with the activity that occurred at each phase.

Phase	Activity	Timeframe
Dialoguing with experts – Professional Learning Day	Discussing student mathematical learning and research based effective pedagogy; modelling the use of resources to support improved student outcomes; and sharing effective learning experiences.	Three times throughout the year
Collaborative planning	Interviews: Teachers reflecting on professional learning day in terms of their pedagogy, mathematical understandings and student learning, and making decisions based on the needs of their students within their particular contexts.	Three weeks after each professional learning day
Classroom implementation	On-site visits: Teachers and visiting experts together implementing effective learning experiences in their classroom	Week 3 – 10 of each term
Collaborative sharing	Teachers sharing with visiting experts, and each other, examples of student learning, adaptations of existing learning experiences, and new learning experiences that they had developed for their particular contexts	Ongoing throughout the year

Table 1: Summary of phases that occurred throughout first year of RoleM

Teacher interviews were conducted by a member of the RoleM research team and occurred after each PD and on-site visit. In all, three interviews occurred throughout the year. Interviews were of 30 minutes duration and conducted by telephone at a convenient time for participants.

Interview questions were emailed to participants prior to the interview allowing them the opportunity to prepare their responses. Four themes around change were embedded in each interview: mathematical knowledge and understandings; perception of student learning and abilities, pedagogical practices, and oral language use. Every teacher was required to reflect on and articulate what and how changes had occurred, or if they had occurred at all. Before each interview, research assistants discussed the types of probes that would be appropriate to ask in order to gather a fuller understanding of each response. All interviews were audio-recorded for later transcription and were clustered according to the time frame in which they occurred.

Data analysis

Data were analysed using a constant comparative method. This method originated from grounded theory and is now widely used in qualitative research (Coombe, 1975). This form of analysis involves the evolution of themes as one continually scrutinizes and categorises the qualitative data (Glaser & Strauss, 1967). *Open-coding* was utilised in the beginning to break down the data into distinct units of meaning. The interviews were transcribed and the text from each cluster of interviews was analysed in an attempt to identify key words or phrases, which

connected the teacher's self-reported beliefs and practices. A fundamental feature of grounded is the application of the *constant comparative* method, which involves comparing like with like and to look for emerging patterns and themes (Lincoln & Guba, 1985). This process facilitates the identification of concepts, that is, a progression from merely describing what is happening in the data, to explaining the relationship between and across incidents. In this study, the constant comparative method involved examining various subsets of the initial data such as, responses from teachers to identify and describe the usefulness of the PD and supplied materials, their impressions of the follow up visits, their beliefs about mathematics teaching, and their beliefs about student learning. This requires a different, more sophisticated coding technique that is commonly referred to as *axial coding* and involves the process of abstraction onto a theoretical level (Glaser & Strauss, 1967). *Axial coding* is the appreciation of concepts in terms of their dynamic interrelationships, and should form the basis for the construction of the theory.

Researchers independently read each transcript, identified and sorted the emergent themes into sub-themes and compared the data across interviews. Consensus was reached concerning the nature of each theme and sub-theme and accompanied by supporting evidence from the transcripts. Where disagreement existed, researchers returned to the raw data gathering excerpts to support particular stances until there was consensus. Data fell into three broad themes: the RoleM (PD) model, teacher knowledge and understandings, and student learning. However, as the year progressed the sub-themes changed. Not all sub-themes were mentioned by each participating teacher. To give insights into the importance of each sub-theme to the cohort of participants, a tally was kept of the number of teachers who mentioned each sub-theme in their interview.

Results

The data is presented in chronological order according to when the interview occurred. Table 2 to Table 4 summarise the themes and sub-themes that arose from the analysed interview transcripts, together with a representative example of a teachers' response for each sub-theme and the frequency of teachers who agreed with that sub-theme.

Theme	Sub-theme	Example from transcript	Frequency
PD Model	PD sessions provided teachers with direction and confidence to teach mathematics effectively	*Switched me on to where I want to push my children. Got me excited again. I knew I wanted to do a maths focus and it gave me direction. It is all there, you can't go wrong.*	20
	Resources were useful and engaging and assisted teachers in the classroom	*I enjoyed being able to do the activities and being able to hear the language we would use and bring back to my kids. The books were great, but seeing it in practise that really worked wonders.*	28
	On-site visits were efficacious for enhancing teacher confidence and knowledge.	*Yes it just clarified some stuff for me. I asked her to do a specific activity the 10 frame and I was checking what I was doing and was good to get the feedback.*	24
Teacher knowledge and understandings	Teachers were not confident in using appropriate mathematical language.	*I don't feel very confident using it... I really like having things set out for me so I know where I am aiming, what to look for how to do it.*	15
	Teachers were becoming aware of the importance of teaching specific oral language for effective mathematics learning.	*[Teacher oral language has] increased since E and E have been coming to the school...Learn to know what language is important.*	15
	For some Teachers play-based learning is not important in their classroom	*Play creates more problems and students don't engage with task.*	6
Indigenous student learning	The language barrier that exists in the classroom impacts on student learning.	*Well if they don't have SAE they can't participate in the lesson because that's the language that I speak to them when I teach. So it affects them greatly.*	25

Table 2: Sub themes from Post PD1 (March) with frequency of agreement (n=31)

The predominant theme that emerged from the first interview related positively to the RoleM (PD) model. Many teachers enthusiastically noted that this was the first time they had seen these types of resources and strategies used to develop mathematical concepts appropriate for their students. While a significant number of teachers felt that they could confidently teach mathematics if they had the resources, language and lesson plans to which they could refer, 49% were less confident in using the appropriate mathematical language. Over 65% of participants

felt PD provided them with the direction and confidence they needed while a further 77% said that their knowledge and confidence to implement effective teaching strategies and activities was enhanced. However, it was the supply of resources and modelling how to utilise these effectively in the classroom that was met with great enthusiasm by 90% of teachers. The weakest theme to emerge related to student learning, with 81% of teachers sharing their struggles with the language barriers that existed in their classroom contexts.

Theme	Sub-theme interview	Example from transcript	Frequency
PD Model	On-site visits were efficacious for enhancing teacher confidence and knowledge.	*...you follow things through.... If you had just dumped a booklet on us and said just make the resources and run with it, it wouldn't have worked so well.*	22
	PD sessions provided teachers with direction and confidence to teach mathematics effectively.	*...it was all the activities and the hands on concrete materials that we have that we can use to engage our students. It definitely opened my eyes on ways to teach maths*.	22
Teacher Knowledge and understandings	Confidence to teach mathematics has grown and their mathematical knowledge and skills has increased	*You gave me a lot of activities and ideas and inspiration and made me think how I can further the activities and incorporate them in my own planning*.	18
	Teachers were more conscious of how and when they use oral language.	*I think I probably use a lot more mathematical language now. It's a lot more explicit, there are a lot more different terms.*	20
Indigenous student Learning	Students were becoming more confident with using mathematical language.	*They seem more relaxed with it...I am seeing the same language being used in different ways in their free play*.	18
	A high level of student engagement was occurring	*They don't really notice that they are doing maths, but they are enjoying it.*	20

Table 3: Sub-themes Post PD (June) interviews with frequency of agreement (n=31).

As the project progressed, of particular interest was the changed emphasis in teachers' comments as they began to reflect on changes that were occurring in both their mathematical knowledge and understandings, and student learning. The RoleM (PD) model continued to be acknowledged by teachers as professionally and personally beneficial, especially in relation to student engagement and learning. Unlike the previous interview where students' language was seen as a significant barrier (81%), teachers were now enthusiastically sharing their students'

marked increase in confidence with using mathematical language (58%) and level of engagement (65%).

Theme	Sub-theme	e from transcript	Frequency
PD Model	Professionally, teachers valued the RoleM model as providing more effective ways to improve teaching and learning.	*It has made my teaching of mathematics easier and covering everything that has to be covered... I probably didn't do that as well before.*	24
	Effective pedagogical practices learnt throughout PD and on-site visits were transferred to other curriculum areas.	*It has filtered through to literacy and science and that type of stuff. I have reflected and changed some of my practices*.	12
Teacher Knowledge and understandings.	Teachers' own understanding of mathematical concepts continue to improve.	*I think it has changed it and it has improved it, there is so much more I can now do, and so many more ways to do things*.	24
	The teaching of mathematics improved as a result of the project.	*It has given me an alternative view point. It's more hands on and given me an alternative to worksheets*.	24
	The use of specific oral language by teachers, pertaining to mathematics has improved	*I use the technical language far more... You don't need to dumb it down*.	23
	Teacher expectations of students' abilities continue to become higher as the project progressed.	*I have much higher expectation because they are achieving so well*.	24
	Structured play is seen to have a valuable role in mathematics teaching and learning.	*I now find it an integral part, that there are other ways to do it than what I was coming up with at the beginning of the year. That is where they build up their language.*	13

Indigenous student Learning	Students were much more engaged, confident and were learning as a result.	*This is the area they enjoy most...they will take whatever they have learned from it and...I will hear them talking about it in everything*.	27

Table 4: Sub themes from Final interviews (Nov) with frequency of agreement (n= 29)

The data collected from teacher interviews consistently supported the transformative contribution that the RoleM professional development model has made to their development as effective teachers of mathematics. Since the beginning of the project in March, between 65% and 71% of interviewed teachers cited that the various aspects of the PD model (onsite visits, professional learning day, links to the National curriculum etc) had been professionally beneficial in providing them with greater knowledge and understanding, and direction to teach mathematics effectively. By November, 83% acknowledged how valuable the RoleM (PD) model was in providing more effective ways to enhance their teaching and student learning, with the same percentage stating that this had resulted in a change to their pedagogical practices (41% claimed that this has extended to other curriculum areas). Making mathematics learning more engaging and fun through structured play-based learning had been instrumental in this. At the end of the year, 45% of teachers acknowledged that both the structured play of the learning activities and the experimental play normally associated with prep, had a valuable role in mathematics teaching and learning in prep and year 1; a contrast to the 19% of participants at the beginning of the project who claimed that play-based learning was not an important aspect in their classrooms.

The RoleM projects' emphasis on the importance of oral language in teaching mathematics and improving student learning continues to be diligently applied by teachers. While many participants (49%) claimed that they were more conscious of the language they used in the initial interviews, by the second round 65% of participants were commenting that they were far more explicit in exposing students to appropriate mathematical language. By the final interview, 79% of teachers claimed that they are ensuring specific oral language is used in incidental teaching situations, such as in the playground, while students are assembling and through various play activities. The inclusion of specific language in the teacher resource books, and questions that enhance student learning, had been noted several times by teachers as being instrumental in guiding them.

It is important to note that the progression of successful learning activities experienced by teachers has energised and excited them, resulting in many positive changes. Changes in pedagogical practices and their consistent use of oral language were recognised by participants as having a corresponding positive impact on students' engagement and learning. By the end of the year, 93% of teachers stated that their students were excited to do maths, more confident to 'have-a-go' and were increasingly using it in everyday situations. This is a considerable jump from the second interview where 65 % commented positively on student engagement and 58% on student confidence. Teachers were increasingly seeing their own pedagogical practices as instrumental in improving student learning outcomes, rather than focussing on their students' lack of proficiency in SAE as the barrier. As a result, 79% of teachers have stated that they now have higher expectations of their students' abilities. While it was expected that this percentage would be higher, several teachers said that they already had high expectations of their students.

Discussion and Conclusion

Through teachers participating in RoleM, learning has arisen that has resulted in a major shift in thinking about the role teachers play in improving student's mathematical engagement and learning. The informal networking and discussions that took place at every professional development venue enhanced this shift. The number of pedagogical and mathematics knowledge epiphanies were numerous, and the excitement generated by these was infectious. Doubting or negative participants were frequently convinced to try various activities by their colleagues who generously shared their experiences; both positive and negative. The groups of teachers at the professional development days, in effect have developed into communities of practice. By the end of the year, participating teachers were less focused on the obstacles to student learning and more focused on the effectiveness of their mathematical teaching and pedagogical practices. A significant number felt sufficiently confident in their professional abilities to be more innovative and experimental in their approach to other teaching areas.

The data presented in this paper offer some important insights into the role a well designed professional development model can make in transforming teachers' pedagogical practices and beliefs. It also raises questions for further investigation. First, the research findings evidence that the RoleM (PD) model provided a directed and transformative pathway that enabled the novice teacher to develop the necessary skills and knowledge to becoming an expert teacher. It is a complex process requiring more than 'one off' discrete training sessions that are limited to general knowledge skills and teaching competencies, and have little impact on student learning. Rather, the development of more effective knowledge skills and pedagogical practices is more likely to occur when an iterative cycle of reflection, collaboration, ongoing support and feedback, and professional learning is more intensive and longer in duration. Cognitive science research stresses that learners who move from being a novice to an expert do so when they have both the factual knowledge and the procedural knowledge to use their new skills (Smith & Gillespie, 2007). We contest that the development of the content knowledge needed for teaching mathematics (Factual knowledge) and pedagogical knowledge of teaching mathematics (Procedural knowledge) go hand in hand. In other words, as teachers engage in assisting students to effectively construct their mathematical knowledge, the teachers' own knowledge of mathematics has the potential to be strengthened and also has the potential to change. Thus as teachers move from being novices to experts, both their understanding of mathematics and how to teach mathematics deepens. Practising new skills and understandings, and then reflecting on their effectiveness in assisting student learning is how new knowledge is developed (Greeno, Resnick & Collings, 1997). The results of this research support the theory that the completion of cycles of RoleM (PD) model supported a pathway of change, guiding the novice learner to becoming an expert. This is a substantive investment to make for teachers in remote and very remote locations given the recurring gap between Indigenous and non-Indigenous students' numeracy outcomes. We conjecture that it has ongoing benefits for all stakeholders. Fundamental to the success of this model is the incorporation of an 'expert' in the area of numeracy, and their willingness to act as an active mentor within these communities.

Second, RoleM's professional development model facilitated a process that shifted the teachers' focus on their role as that of predominantly behavioural management and baby-sitting to that of feeling in control of supporting student learning. As the year progressed, most teachers were focussing far less on what they saw as the deficits of Indigenous student learning in mathematics. Instead, focus shifted to these teachers growing mathematical competencies in using appropriate oral language, and stimulating and well-structured hands-on activities/resources to engage, motivate and scaffold students' learning. Through changing their pedagogical responses to student learning, both experienced and novice teachers were becoming more effective implementers of curriculum.

Many teachers in these rural and remote locations often become dissatisfied. The results from past research suggests that teacher's low self-efficacy, lack of motivation and job dissatisfaction is determined by the belief that they are not having any positive impact on student learning (Sharplin, 2008). This can drive teachers to uncritically and unconsciously adopt a deficit model of teaching. The common pedagogical response is a highly structured classroom, repetitive learning, dumbed down curricula, a reliance on worksheets, less time given to teaching and lowered expectations (Hewitson, 2007; Munns et. al, 2008). Students are given simple achievable work so they are not faced with the possibility of academic failure. It mirrors what Haberman (1991) termed a 'pedagogy of poverty' - a cycle of non-achievement, non-engagement and perpetual poverty. Munns (2005) describes this as 'cubby house' pedagogies, a reference made by an Indigenous student about school being like a cubby house; you come to the cubby house and have fun, go out for lunch and come back again. Participation in RoleM resulted in re-engagement by these teachers as active instigators and supporters of student learning.

Third, the factor that had the most impact on changing teachers' beliefs and attitudes was observing the increased engagement and excitement with mathematics by Indigenous students at the initial stage of the project. To reiterate what Guskey (1988) pointed out, fundamental to authentic change in teachers' attitudes, beliefs and practices is knowing that these changes are having a positive impact on student learning. We believe that these changes would not have happened so readily without the 'delivery' of proven learning experiences that teachers were required to implement immediately and then evaluate in relation to student learning. We also conjecture that experiences of success need to happen 'quickly' for teachers to maintain momentum, enthusiasm and consistency in delivering the mathematics curriculum within a new pedagogical framework.

Finally, the frequent transition of new teachers in and out of these isolated communities often results in a paucity of pedagogical wisdom on which new teachers can draw. Nor are they there long enough to make substantial deposits that benefit the next round of transitioning teachers. It can be a time consuming cycle of continually reinventing the wheel with each new transition. The key question is that once structures have been established and contextually and culturally appropriate learning experiences have been developed, can these materials stand-alone. If not, what type of professional learning support is required to ensure ongoing engagement of both the teachers and students within these communities? This is the question we are presently addressing in the second year of RoleM.

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