



## **Educators' perceptions of the Role of Language when Kindergarten Children Learn Numeracy**

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### **Abstract**

This paper employs a collaborative auto-ethnographic method to reflect on the role of language when kindergarten children (three-five-year olds in a prior to school setting) communicate, make meaning and model the language of numeracy. The research data included the retrospective reflections of three kindergarten educators and three teacher educators, and a review of literature. A four-phase analysis on the role of language in kindergarten children's learning of numeracy was conducted. The thematic analysis of the data identified two educational aspects of language use where a modified approach may benefit children's numeracy development: (1) the creative use of language to promote an active learning environment, and (2) the creative use of language to build and communicate numeracy ideas. The paper then discusses insights and possible developments for the practice of teaching and learning of numeracy in kindergarten classrooms.

**Keywords:** kindergarten children, learning numeracy, language

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### **Background**

"... mathematics education begins and proceeds in language, it advances and stumbles because of language. And its outcomes are often assessed in language. Such observations could be made of most school curricula, but the interweaving of mathematics and language is particularly intricate and intriguing..." (Durkin, 1995, p.3)

The Early Years Learning Framework (EYLF) (Department of Education, Employment, and Workplace Relations [DEEWR], 2009) suggests that positive attitudes and competencies in numeracy and literacy are essential for children's successful learning and that the foundations for these competencies are built in early childhood. The Australian Early Development Census (AEDC) assesses children in their first year of formal schooling and considers children developmentally 'at risk' if they have not developed the following numeracy skills: counting to 20; recognising shapes and numbers; comparing numbers; sorting and classifying objects; and understanding simple time concepts. Children are also considered developmentally 'at risk' if

they have not developed some of the communication skills like listening, understanding and speaking effectively, being able to articulate clearly, being able to tell a story and to take part in imaginative play (Commonwealth of Australia, 2016).

All early childhood education contexts can be places where children investigate, talk about, and make sense of their emerging numeracy and mathematics ideas. In the Australian educational context, a subtle distinction is made between numeracy and mathematics. The EYLF conceptualises numeracy as children's capacity, confidence and disposition to use mathematics in their daily life. This perspective implies that numeracy and mathematics are related but not identical. The *Australian National Numeracy Review* positions numeracy and mathematics as clearly interrelated. "All numeracy is underpinned by some mathematics; hence school mathematics has an important role in the development of young people's numeracy" (Commonwealth of Australia, 2008, p.11).

Numeracy can be described as a key outcome of mathematics education. Children's numeracy increases as they develop the ability to use mathematics within an ever-increasing variety of contexts in which it needs to be used in their everyday life (National Curriculum Board, 2009).

### **Language in Numeracy Development**

Children are social beings and from birth, they start to communicate with others using gestures, sounds, language and assisted communication (DEEWR, 2009). According to Demetriou, Spanoudis and Mouyi (2011) as young children grow they start to deal with increasingly more complex representations of their world, and the emergence of language during their second year of life brings these representations into focus so that they can talk about, reflect upon and elaborate on them. DeLoache (2000) observed that at the age of three to four years, children start to differentiate these representations from each other and from the objects, they represent. This means that kindergarten children at the age of three to four start to differentiate objects and use language to describe the objects. This development can be used by educators to inform the interrelated roles of language when children learn numeracy. These roles include the communication/facilitation role, the making of meaning, and modelling the language of mathematics and numeracy (Macmillan, 2013).

Language plays a central role in numeracy development. Children use language to communicate numeracy ideas, not only to other people but also to themselves as they refine and clarify those ideas in their minds. It is imperative to recognise that language is more than just spoken and written communication. It also includes pictorial representations like diagrams, active representations like performance and demonstrations, and imagery (Bobis, Mulligan & Lowrie, 2013; Montague-Smith & Price, 2012). Davis, Goulding and Suggate (2017) observed that children increased their numeracy understanding when they communicated their mathematical ideas to others. Bobis, Mulligan and Lowrie (2013) suggested that early childhood educators actively encourage children to engage in communication processes such as discussions and explanations to help them develop and share their numeracy ideas and understandings.

To aid children's development of numeracy, the role of language needs to be well-articulated in early childhood educational contexts. Macmillan (2013) highlights three interrelated roles of language when children learn numeracy; the language roles are consistent with EYLF

recommendations. The first language role is communication, which is often associated with text types. This role focuses on language and its facilitation role when children learn numeracy. Davis, Goulding and Suggate (2017) described this role as looking at numeracy meanings expressed in language. This can include the natural everyday home languages children use to learn and develop the formal language of numeracy. The EYLF argues that children's use of their home languages underpins their sense of identity and their conceptual development and thus needs to be valued (DEEWR, 2009).

The second language role is associated with how children use language to make meaning when developing their numeracy ideas. This role focuses on children becoming aware of what they are doing by talking about it (Macmillan, 2013). To develop this role of language, Davis, Goulding and Suggate (2017) suggest explicit activities designed to get students thinking and expressing their ideas out loud to promote the role language plays in building up those numeracy meanings. The EYLF argues that it is important for children to interact with others and explore ideas and concepts, clarify and challenge their thinking, negotiate and share new understandings (DEEWR, 2009).

The third language role is associated with children modelling the language of numeracy (Macmillan, 2013). The EYLF suggests that it is important to use concrete, or 'real-life' resources to promote children's use of mathematical language. Children need to use language to communicate their thinking about quantities; describe attributes of objects and collections; and explain their mathematical ideas. They also need to demonstrate an increasing understanding of measurement and number, using vocabulary to describe size, length, volume, capacity and names of numbers (DEEWR, 2009). Halliday (1978) observed that this role of language results in children acquiring the mathematics register, which is the specific uses of language for mathematical purposes.

This paper draws from an auto-ethnographic method to examine participants' perceptions of kindergarten children's use of language to learn and communicate their numeracy ideas in two kindergarten classrooms in Far North Queensland (FNQ). The participants are three kindergarten educators and three university teacher educators. The approach challenges canonical ways of doing research and treats research as a political and socially-conscious act. The participants use tenets of autobiography and ethnography to do and write auto-ethnography. Thus, as a method, auto-ethnography is both process and product (Ellis, Adams, & Bochner, 2011). Our specific approach to auto-ethnography is collaborative. The next section describes our collaborative auto-ethnographic approach.

## **Methodology**

Partnerships in all aspects of early childhood education enhance both the teaching and learning experience (Arthur, Beecher, Death, Dockett & Farmer, 2015). This collaborative project resulted from a visit by the three university teacher educators (Philemon, Cliff and Reesa) to a local kindergarten centre to talk with the three kindergarten educators (Todd, Christine and Barbara), who were concerned that their kindergarten students might not be accepted into what the kindergarten educators termed a 'good' primary school. Primary schools in the area surrounding the Early Childhood Centre conduct interviews with children as prospective enrollees prior to accepting them into the school. The kindergarten educators wanted to develop a tool to enhance the students' numeracy. Todd noted:

*It is important to work together to network and expand on our current network and partnerships. This way we can collaborate, plan and implement pre numeracy skills in our early childhood setting.*

Philemon reflected:

*For me the aha! moment in my first meeting happened when Todd was talking about the need to enhance the numeracy skills of their kindergarten students. Todd reported that parents were worried that their children might not attain the numeracy levels, including counting skills, to enter the 'good' schools. He noted that parents want their kids to go to a 'good' school, however, the so called 'good' schools interview children before enrolment. One of the main skills required is counting up to 20 and recognising group sets. This is why Todd wanted to improve the learning and achievement levels of the centre; it was a response to the parents' call.*

The three university teacher educators arranged to meet fortnightly over three terms with the kindergarten educators to discuss ideas about how they might enhance the numeracy practices. These meetings were also reflective discussions.

This paper employs a collaborative auto-ethnographic approach to examine narratives of three kindergarten teachers and three university teacher educators regarding the role of language when kindergarten children (three-five year olds in a prior to school setting) learn and communicate their numeracy ideas. Auto-ethnography is an approach to research and writing that seeks to describe and systematically analyse personal experience (auto) in order to understand cultural experience (Ellis, Adams & Bochner, 2011). Chang, Ngunjiri and Hernandez (2016) describe collaborative auto-ethnography as “a qualitative research method that is simultaneously collaborative, autobiographical, and ethnographic” (p. 17). Some auto-ethnographers focus more on self, while others adopt a more analytical stance, focused on the cultural interpretation of events involving self (Chang, Ngunjiri & Hernandez, 2013; Ngunjiri, Hernandez & Chang, 2010). This paper takes the form of an analytical approach to auto-ethnography. The research questions that guided our investigation were:

1. What do we perceive is the role of language when kindergarten children communicate, make meaning and model their numeracy ideas?
2. How can we implement strategies to enhance kindergarten children's use of language to communicate, make meaning and model their numeracy ideas?

Auto-ethnography is systematic in its approach to data collection, analysis and interpretation, and the researcher is both the subject and object of the research (Ngunjiri, Hernandez & Chang, 2010). Chang (2013) argued that when researchers work together to co-generate story, listen, stir memory, prompt action and reaction, examine and challenge assumptions, they produced rich, nuanced, and varied perspectives. The three kindergarten educators (Todd, Christina and Barbara) and three university teacher educators (Philemon, Cliff and Reesa) had face to face meetings every fortnight over three terms to explore the role of language when kindergarten children learn numeracy and possible modifications to enhance the practice of teaching and learning.

Research data included the retrospective reflections about the program and numeracy practices of the three kindergarten educators and three teacher educators, and a review of literature about language development and use while children learning numeracy. A four-phase analysis was implemented. In Phase 1, we reviewed literature on the role of language in children's learning

of numeracy. In Phase 2, we reviewed and reflected on the kindergarten collaboration program. In Phase 3, we analysed the retrospective reflections of three kindergarten educators and three teacher educators about kindergarten children's use of language when learning numeracy. In Phase 4, we reflected on possible developments to the practice of teaching and learning in the kindergarten classrooms. Chigeza and Sorin (2016) argued that early childhood educators need to restate more clearly how young children develop numeracy skills and conditions that influence their learning. The next section highlights contemporary thinking on how young children learn.

### **Retrospective Reflections of the Teachers**

This section reports on narratives of the three university teacher educators and three kindergarten teachers on the kindergarten children's use of language to communicate, make meaning, and model the language of mathematics and numeracy (Macmillan, 2013). As highlighted earlier, educators need to restate more clearly how young children use language to develop numeracy skills and conditions that influence the learning (Chigeza & Sorin, 2016). The following is a reflective exchange between the educators.

**Philemon:** *To me, an example of the communication and facilitation role of language is during Rote Counting, that is, when students recite the counting sequence (including using their home languages), but they may not always be able to maintain a correct correspondence between the objects being counted and the number names. When students develop correct correspondence between the objects being counted and the number names, they are developing meaning with number counting. However, I think that it is when students move between and within the different ways of representing the numbers that they develop deep understanding of numbers. Modelling the language of mathematics (i.e. using the mathematics register) happens when students are Rational Counters, that is, when they not only use the one-to-one correspondence but are also able to answer the question about the number of objects being counted (Reys et al., 2016). The focus should be on moving students from being rote counters to rational counters.*

**Reesa:** *What you are describing here seems to be the progression of numerical understanding and the integral role that language plays in the process. I would represent it in a table, as follows:*

<i>Numerical Process</i>	<i>Language Input</i>	<i>Examples</i>
<i>Rote counting</i>	<i>Offering children the names for numbers. Children listen and repeat.</i>	<i>One – two – three- four – five. Children repeat after educator</i>
<i>Correct/ one to one correspondence</i>	<i>Relating the number name with concrete objects (such as children in class)</i>	<i>Counting children in the class as you tap their shoulders: One, two, three, four, five</i>
<i>Moving from concrete to abstract</i>	<i>This could be considered the next step. Children can already rote count and count using one to one</i>	<i>Here they are using both the words for the numerals and for the objects being counted. This then moves to drawings, photos or three-dimensional figurines, as they count: one person, two people,</i>

	<p>correspondence. Next they need the names of: objects they are counting, pictorial objects and pictorial representations of numerals.</p>	<p>three people, four people, five people. From here, they are shown flash cards, first with dots (1 – 5) and then numerals (1 – 5). They begin to associate the numerals with the number of dots, as they did the spoken numeral with the concrete object. Finally, they see (or write) the numeral and understand what it means without support of visual images.</p>
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Table 1: Numerical Process and Language Input

As you can see, all of these ‘stages’ require specific language input and it is through modelling and offering the vocabulary that this can be achieved.

Most educators are keen for young learners to engage in active hands-on experiences when learning mathematics and numeracy, and the concrete - pictorial (semi-concrete) - symbolic (abstract) model is a good and useful starting point as highlighted by Philemon and Reesa. This can help young children to develop meaning with the mathematics and numeracy concepts as suggested by Van de Walle, Karp and Bay-Williams (2013). However, it is equally important for educators to articulate on the specific role of language when children communicate, make meaning, and model the language of mathematics and numeracy (Macmillan, 2013) as the young learners engage in this concrete - pictorial - symbolic learning process. There is need for educators to reflect on the role of language (both spoken and written) and on whether children are developing the required procedural text as well as the necessarily underlying relationships with numbers. Cliff reflects on the need for young children to understand the underlying mathematical relationships.

**Cliff:** *Counting is, at a basic level, a procedural text. Children can learn the order of the number names without understanding the relationships between the numbers. An analogous situation can occur when learning the alphabet. The alphabet as an example of a series of names that children learn, often through the process of rote learning. Children learn the particular order but not necessarily any underlying relationships. It is interesting to observe that when adults are asked to list the alphabet they often sing rather than speak the letter names. Similarly, if you ask a person questions related to the order of letters, for example to state the letter that precedes the letter q or to state the tenth letter of the alphabet, they will often need to recite the alphabet starting with the letter a before they can answer your question. The same process of connection free procedural only learning can occur with learning the names of a sequence of numbers. A consequence of learning the number names as a procedural text may mean children enter school at a disadvantage because while they can recite the number names in order up to for example twenty they do not have an understanding of how the numbers are related to one another (Siemon et al, 2015). It will be more difficult for those children to develop initial mathematical ideas in the school settings such as skip counting, addition and subtraction. It is important to have a language to describe to yourself and others what you are doing mathematically but it is also important that that language is connected to an understanding of mathematical relationships (Hiebert & Lefevre, 1986).*

The Age-appropriate pedagogies for the early years of schooling report specifically calls for active, agentic, collaborative, creative, explicit, language-rich and dialogic, learner focused, narrative rich, playful, responsive and scaffolded learning environments (Queensland Government, 2016). Educators must articulate how this environment might look like in practice and how the creative use of language can play a threading role to enhance the suggested

characteristics of the learning environment. The following is a reflective exchange between the educators.

**Philemon:** *To me these language roles when children learn numeracy are clearly interrelated. However, I need to develop a structure I can develop with my Bachelor of Education (Early Childhood) preservice teachers as a starting point to help them think about these roles of language in learning numeracy in early childhood. The development is obviously not linear, more like spiral. I think there should be emphasis at different points during the learning process, spiral or trajectory. My thinking is that the communication and facilitation role comes first and should be emphasised initially to help inform or support the meaning making of numeracy ideas, and these two language roles help to model the language of mathematics and numeracy (mathematics register).*

**Christina:** *I agree with Philemon's perspective that language roles are intertwined. There is a symbiotic relationship between the three roles of language as manifested in the pre-numeracy learning process. Communication and facilitation roles are the initial links that lay the foundation in the pre-numeracy learning context. A good example is when children play the game, "What's the time Mr Wolf?" When they sing the lyrics of the song they are communicating using the language of Maths and applying their numeracy skills as they apply the concept (of counting in sequence depending on what time it is on Mr Wolf's watch). They respond by harnessing their numeracy skills counting in sequence using the 12 time notation. The question and answer game is repeated as they continue to count in sequence until the game is over.*

*More so, another example of what has proven to work this year in our room is learning Mathematical concepts through singing nursery rhymes like; ten little monkeys jumping on the bed, 10 little ducks, Johnny had a hammer to name a few. The nursery rhyme have enabled children to practice counting in doubles and learning the basic concepts of addition and subtraction which will be pivotal to further enhance their grasp of basic numeracy concepts. I think the exposure to these concepts has laid the foundation for a healthy relationship with numeracy.*

**Reesa:** *I agree, Christina. Music, and indeed all of the Arts, are wonderful ways to support children's numeracy learning (and learning in other areas). The Arts make learning enjoyable and increase students' engagement in the learning. In the examples you gave, such as 'What's the time, Mr. Wolf?' another factor that makes the learning engaging is the movement associated with the song. After Mr. Wolf states the time, for example 'three o'clock' the children move forward three steps. They are using their bodies as well as their voices, having fun, AND learning!*

Educators must articulate more clearly on the age-appropriate pedagogies and activities that engage high levels of concentration, interest and enjoyment for the young learners (Queensland Government, 2016). It is also helpful for teacher educators to develop such a framework so that Bachelor of Education (Early Childhood) preservice teachers can adopt the framework as a starting point. The framework can help preservice teachers think about the roles of language when young learners communicate, make meaning, and model the language of mathematics and numeracy (Macmillan, 2013). The following is a reflective exchange between the educators.

**Barbara:** *In a group situation with 3 year olds, we use counting numbers out and loud while patting our knees or clapping our hands to set up a rhythm and pattern of sequencing. This is applied at every opportunity where the children can become familiar with the correct sequencing 1 – 10 to begin with then 1 – 20. We use forward and backward counting to facilitate movement between activities, pack up time or outside time. This is done in an inclusive and fun*

way e.g. 5, 4, 3, 2, 1, 0, blast off!!! We also use resources to develop the language of mathematics, that is, matching a variety of items (glass beads, mini animals, plastic counters) to a domino card. Do we add or take away to get the correct numbers. Are there more or less? We also use laminated domino cards and numbers in the children's bag lockers, they are able to choose their number daily and their parents/carers are also engaged in using mathematical language. We also take advantage of environment opportunities, for example, a student counted some rocks (11) and she used 8 rocks to make the image of a person. I asked her how many left? She looked at me so I pointed to what was left and said: 'LOOK YOU HAVE NOT USED 3 SO 3 ARE LEFT'. She looked puzzled. We checked over the numbers again by counting all the rocks – 11 you used 8 and there are three left. The smile on her face was one of discovery and recognition. It was fun.

**Cliff:** That is brilliant Barb. You are assisting the children to access and use the numbers in different but connected ways. The connections they develop will assist their depth of understanding of the inherent relationship in mathematics. The challenge for me is to think of how to design or choose existing resources that the children will want to play with and will at the same time develop their language of mathematics and understanding of numeracy. In school settings, the teacher designs lessons with set student learning outcomes and associated success criteria. My initial conceptualisation of numeracy in kindergarten was very much biased by my experience in schools. It took a while for me to recognise that children will interact or not interact with activities and resources in their own time and in their own way. Opportunities for intentional teaching aside, the challenge as I see it is how do we provide children with opportunities to regularly play with resources that stimulate their numeracy development. How do we assist children to gain the language necessary to grow their understanding of numeracy?

**Christina:** We can assist them by setting out activities that scaffold their interest depending on the time, season and what is popular, and for example, nowadays the new Aquarium is popular, or Christmas activities with a numeracy twist like the candy cane fine motor counting activity.

The need for a range and balance of age-appropriate pedagogies and the learning of literacy and numeracy is fundamental in the early years for all children (Queensland Government, 2016). Lesh, Cramer, Doerr, Post and Zawojewski (2003) encouraged children to move between and within the five different ways of representing mathematics and numeracy ideas: real-world situations, manipulative models, pictures, oral/written language, and written symbols. Thus, language plays a central role when children move between and within the different representations and should be a tool for making meaning with the mathematics and numeracy ideas. To further develop the practice of teaching and learning in kindergarten classrooms, educators need to articulate more clearly the deliberate, purposeful and thoughtful actions that promote children's innate drive for learning and their use of language to communicate, make meaning, and model the mathematics and numeracy ideas (Queensland Government, 2016; Macmillan, 2013). The next section highlights the possible developments to the practice of teaching and learning in the kindergarten classrooms.

### **Possible Developments to the Practice of Teaching and Learning**

As highlighted earlier, language is more than just spoken and written communication; it also includes pictorial representations like diagrams, active representations like performance and demonstrations, and imagery (Bobis, Mulligan & Lowrie, 2013; Montague-Smith & Price, 2012). Language is a tool that educators can use to promote children's innate drive for learning mathematics and numeracy ideas (Murphy & Hall, 2008; Vygotsky, 1978). Language is also a tool that kindergarten children use to communicate, make meaning, and model the mathematics

and numeracy ideas (Queensland Government, 2016; Macmillan, 2013; DEEWR, 2009). Two areas of possible development emerged from a thematic analysis of the literature on the role of language in kindergarten children's learning of numeracy; the kindergarten collaboration program; and retrospective reflections of the educators' perspectives on numeracy in kindergarten classrooms. The two areas are: (1) the need for creative use of language that promotes an active learning environment for all kindergarten students; and (2) the need for creative use of language to build and communicate the numeracy and mathematical ideas for all kindergarten students.

### ***Creative use of Language to Promote an Active Learning Environment***

There is need for teaching approaches in kindergarten classes that enhance creative use of language to promote active learning environments for all kindergarten students. Such frameworks can enhance kindergarten children's innate drive for learning and sharing of mathematics and numeracy ideas (Murphy & Hall, 2008; Vygotsky, 1978). The *Age-appropriate pedagogies for the early years of schooling* report supports scaffolded learning environments that are active, agentic, collaborative, creative, explicit, language-rich and dialogic, learner focused, playful, and responsive to all the children's needs (Queensland Government, 2016). Early childhood educators must articulate how the environments look in practice and how creative use of language can play a threading role to promote the suggested characteristics of the learning environments and enhance the innate drive for kindergarten students to develop their numeracy ideas.

In the reflective exchange, Christina proposed that language communication and facilitation roles are the initial links that lay the foundation in the pre-numeracy learning context and provided an example with the nursery rhyme. Nursery rhymes enabled children to practice counting in doubles and learning the basic concepts of addition and subtraction, which are pivotal to further enhancing their grasp of basic numeracy concepts. This position is echoed by the age-appropriate pedagogies for the early years of schooling that encourages activities that engage high levels of concentration, interest and enjoyment for young learners (Queensland Government, 2016). However, Cliff argues that the learning of kindergarten children should go beyond the procedural text of reciting the number names in their order, as this position can disadvantage children when they enter formal schooling. Our resolve is that it is not enough for kindergarten students to know how to recite number names in order; they also need to develop an underlying mathematical understanding of number relationships. We intend to build on the age-appropriate pedagogies for the early years of schooling and focus on how the communication (i.e. spoken, active performance, demonstrations, etc.) can be used to capture the interest of all kindergarten students and give the students not only the opportunity to experience success and enjoyment, but build their confidence in numeracy. This is a central pillar that can enable kindergarten students' enhanced concentration, interest and enjoyment when developing the numeracy ideas.

During the reflective exchange, Reesa argued that the Arts are wonderful ways to support children's numeracy learning and that the Arts make learning enjoyable and increase students' engagement in the learning. Similarly, Barbara's experience was that when having group times with 3 year olds, counting numbers out and loud while patting their knees or clapping their hands to set up a rhythm and pattern of sequencing enhanced their concentration, interest and enjoyment while concurrently developing their number counting skills. This is echoed by Bobis, Mulligan and Lowrie (2013) as well as Montague-Smith and Price (2012), who argued

that the language children use should be more than just spoken and written communication, but should also include active performance and demonstrations, pictorial representations and imagery. Our experience is that it is quite possible to scaffold kindergarten children to develop not only spoken communication, but also active performance and demonstrations while learning. Teacher educators and kindergarten teachers can develop new sets of pathways that enhance creative use of language to capture the interest of all kindergarten students and give them an opportunity to experience success and enjoyment, as well as build their confidence in numeracy. Our position is that, just like one can encourage a positive sporting environment and innate drive to keep competing by cheering on one's team (sometimes with use of a 'cheer squad'), it is quite possible to develop supportive teaching environments that incorporate creative use of language to cheer on the kindergarten students to build an innate drive to keep developing their numeracy and mathematical ideas.

### ***Creative use of Language to build and communicate numeracy ideas***

Teaching approaches in kindergarten classes can enhance creative use of language to build and communicate kindergarten students' numeracy ideas. As highlighted earlier, Montague-Smith and Price (2012) observed that young children often give a running commentary on their actions, talking through a task to enable them to carry it out successfully, and that as they grow older, the running commentary may not be spoken out loud but internalised, leading to more advanced forms of thought and reasoning. We feel that continuing to encourage the children's out loud running communication, as they grow older, will encourage the sharing of developing ideas and internalising of numeracy concepts. This can also lead to advanced forms of thought and reasoning. As suggested earlier, the out loud running communication can be more than just spoken communication, it can also include active performance and demonstrations, as well as pictorial representations and imagery (Bobis, Mulligan & Lowrie, 2013; Montague-Smith & Price, 2012).

During the reflective exchanges, Cliff observed that the main challenge is to design learning activities that the children will want to engage with and at the same time develop their language of mathematics and understanding of numeracy. To design such a learning activity, Barbara described how she took advantage of the environmental opportunities during the counting of the rock activity described earlier. She probed the student, while pointing to the rock arrangement to enhance spoken communication, active performance and demonstrations that led to development of the student's numeracy ideas. Our thinking and position aligns with the age-appropriate pedagogies (Queensland Government, 2016), Macmillan (2013) and the EYLF (DEEWR, 2009) who suggest that different forms of communication (i.e. spoken, active performance, demonstrations, etc.) play crucial roles when children move between and within the different activities and numeracy representations and should be the central tools and focus for making meaning with the mathematics and numeracy ideas.

Early childhood educators can articulate more clearly how to provide young children with opportunities to regularly play with resources that stimulate their numeracy development and enhance the children to use the different forms of communication (i.e. spoken, active performance, demonstrations, etc.) to move between and within the different activities and numeracy representations. Using the different forms of communication and moving between and within the different activities and representations play an important role in building and communicating numeracy knowledge. As previously suggested, the age-appropriate pedagogies for the early years advocates for learning environments that are active, agentic,

collaborative, creative, explicit, language-rich and dialogic, learner focused, playful, and responsive to all the children's needs (Queensland Government, 2016). Our hope is for early childhood educators to develop learning environments that encourage young children to interact with activities and resources in their own time and in their own way, but also encourage the children to use the different forms of communication (i.e. spoken, active performance, demonstrations, etc.) to develop the numeracy ideas, to internalise the numeracy ideas and to share their developing numeracy ideas.

## **Conclusion**

This collaborative auto-ethnography process has enabled us to reflect on our practice for future iterations in two areas. The first involves implementing teaching approaches in kindergarten classes that enhance creative use of language to promote active learning environments for all kindergarten students. The approaches can enhance kindergarten children's innate drive for learning and sharing of mathematics and numeracy ideas. The second involves implementing teaching approaches in kindergarten classes that enhance creative use of language to build and communicate kindergarten students' numeracy ideas. The approaches can play an important role in building understanding and communicating of the numeracy knowledge. This collaborative auto-ethnographic process has highlighted the importance of placing different forms of communication (i.e. spoken, active performance, demonstrations, etc.) at the heart of our thinking about kindergarten children's learning of numeracy. Our hope is to encourage further research about how young children use these different forms of communication to develop numeracy ideas; to internalise numeracy ideas; and to share their developing numeracy ideas.

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