Parental Perspective on Teaching Number Sense to Young Children (One to Five Years Old)

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Abstract
The first author is a former mainstream school mathematics teacher and the second author is his wife, used to be an allied educator before she resigned to be a homemaker. Together they have three daughters, Oli[22] (five years old), Ven[23] (three years old) and Ely[24] (one year old). Their first two daughters, Oli and Ven, currently attend pre-school enrichment classes for about three hours per weekday. At home, the parents teach them numeracy and literacy skills for around 30 to 45 minutes a day. The two authors have explored various ways to engage, enrich and enlighten their children in learning mathematics. They acknowledge that every child is unique and learns differently at every stage of his/her development. As such, the authors have employed a repertoire of mathematics teaching strategies to cater to their children's learning needs, especially in making sense of numbers. One of the key challenges the authors have encountered is finding a meaningful way to make mathematics learning fun and relevant. In this paper, they have chosen to share, from their parental perspective, how to teach number sense to young children.
Keywords: Mathematics Learning, Numeracy, Number Sense, Teaching Methods

Introduction

In today's competitive and fast paced economy, the ability to solve problems through mathematics is considered critical. This is especially true in Singapore's fast paced workforce where one who possesses such skills is often seen as valuable to any organization. Major corporations believe that such a quality may translate to higher productivity and efficiency to the company or society. Hence, one with good mathematical ability is often deemed as an asset in any organization to solve problems. As the employment rat race continues to remain competitive in Singapore's context, one should start from young and enrich their children with mathematical experiences so as to enhance their mathematical abilities (Ritchie & Bates, 2013; Watts, Duncan, Siegler, & Davis-Kean, 2014).

Anecdotal evidence suggests that it is becoming increasingly difficult for children to bridge their mathematical abilities later in their school life if little or no intervention is provided to help them at a young age (Aunola et. al., 2004; Bodovski & Farkas, 2007). The lack of mathematical ability may persist because many children have underdeveloped mathematical skills and knowledge, and as a result, manifest low confidence in achieving mathematical success (Gervasoni & Perry, 2017). In addition, further research suggests that there is a direct correlation between a child's inability to make sense of numbers in their early years and poor mathematics learning in their elementary years (Gersten, Jordan, & Flojo, 2005). These conclusive research results indicate that a strong mathematical foundation and attention to early mathematics education as well as instruction is vital to enhancing a child's mathematical achievements at a later stage, especially preparing the child for school readiness (Duncan et al., 2007).

All children are natural mathematicians and that parents are children's first teacher (Vukovic, Roberts, & Green Wright, 2013; also see Marshal & Swan, 2010, for detail). Parents' (and later working collaboratively with teachers when their children go to school) involvement in teaching their child can help the child to realize his/her potential earlier by assisting them to uncover and unpack these strengths through play. Play is a very powerful enabler to opening a child's mathematical world (Ramani &

[22] Not the first child's real name; a pseudonym has been used.

[23] Not the second child's real name; a pseudonym has been used.

[24] Not the third child's real name; a pseudonym has been used.

Eason, 2015; also see Tirosh et al., 2020, for further detail). When play is meaningful and fun, the children can gain a deeper understanding of number, quantity, size, patterning, and data management (Grossman, 1996).

There are three operating principles the authors have built on when teaching number sense. Firstly, it is to seek every possible opportunity to learn and communicate mathematics in a fun and simple way (Moyer, 2000). In this way, a child's curiosity would be aroused and learning can take place constantly. Integrating mathematical language in everyday communication (Perry & Dockett, 2008) could further contribute to the opportunity of learning mathematics. This could come in the form of using terms such as 'addition' or 'subtraction' when referring to an event where items are added or removed. Communicating in mathematical language such as adding the number of cookies or taking away or hiding the number of toys could also contribute to learning mathematics. Secondly, it is to create a safe and positive learning environment. The home as a numeracy environment or simply home numeracy environment (Rathé et al., 2020) is a good place for the authors' children to start learning mathematics and making mistakes in their pursuit of acquiring mathematical concepts and skills. Studies have shown that a child's home numeracy environment plays an important role in a child's number sense acquisition (LeFevre et al., 2009; Skwarchuk et al., 2014) within the context of home as it presents a safe place for trial and error. Lastly, it is to celebrate every possible success no matter how big or small in mathematics learning Everyone, including adults, want some form of affirmation and encouragement when executing their tasks. It is no different for any other children as it would empower their mathematics learning and build a stronger parent-child bond (Rahmawati & Amri, 2020).

Teaching Ely (one-year-old) number sense

A key developmental milestone is that at one-year old, children develop an explorative attitude towards everyday objects and how they function. Ely, being the youngest of the authors' three daughters, likes to meddle with objects and may explore objects largely through her senses of taste, touch, smell and sight. The child displays a keen sense of touch and movement (tactile-kinesthetic) such as pushing the door, opening the cupboard drawers and taking out toys (see Baccaglini-Frank, 2018, for detail). In this trial-and-error exploration stage, it is an opportune time to facilitate her number sense by introducing the following steps/activities:

(1) *Counting whenever possible.*
Parents should seize every opportunity to count objects or everyday items with the toddler. For instance, counting the number of cookies on a plate, counting big and small goldfish in a bowl/fish-tank or counting different shapes and sizes of toys in a box. Parents should explicitly point to the object or guide the child's finger to point as the parent(s) count(s). This will enable and enhance the child's numeracy awareness. Progressively, the child would associate counting numbers to the number of objects, a useful method known as one-to-one correspondence.

Picture 1. Ely taking out soft balls as parents count 1, 2, 3

Picture 2: Ely clapping her hands to the song with counting rhythm

(2) *Singing counting songs out loud.*
Numerous counting songs can be found on Youtube as these videoclips provide very catchy jingles and nursery rhythms. Some examples include '1 little 2 little 3 little monkeys' or "Six little ducks went out one day …". Parents can sing the songs during playtime or naptime and, if possible, use a toy for each number sung in the song so that the child can relate to it. It is good to encourage the child to sing along and eventually, s/he will learn how to sing it him/herself. This allows a rhythmic counting impression to be formed in the young mind.

(3) *Reading with the child.*
Reading counting picture books as well as other printed materials relevant to numeracy and mathematics can form new numeracy domains in children. One benefit is that it enables a child to think and communicate mathematically (Moyer, 2000) and gradually the child will create his/her own mathematical ideas over time (Perry & Dockett, 2008). Consistent reading of counting books to children allows them to learn how to connect numbers to the correct quantity of objects illustrated in the book. Some recommended books include the following: 'Baby's First 123', Dr. Seuss's '123' and '10 little You's'. For more interesting counting books that parents and teachers can use with children, please refer to McDonald (2007) for detail.

(4) *Playing with toys*.
Using cause-and-effect toys (e.g., a squeaky rubber duck to play with the child) can promote the fun of learning mathematics. Any parent may start counting as s/he presses the rubber duck, and thus helping the child to associate the number of squeaks with the number spoken by the parent. Also, parents need to allow their child to press the rubber duck and count the number of squeaks. When keeping the toys, parents could also count the toys as the child places them back into a box or container. This may inherently cultivate a good habit and discipline of ensuring the correct number of toys taken out is put back.

(5) *Using pictorial number flashcards*.
Using flashcards in drill-and-practice has its advantages as these cards are easy to create and they can be used individually or in groups (Reynolds, 2010). The use of flashcards aids in reinforcing numbers at an early stage. For instance, a flashcard with one dot represents the number one, two dots represent two and so on. Parents can use flashcards with one to three dots at the start of an activity, once a day for three weeks. One of the teaching strategies found to be useful is repetitive teaching. It allows the child to concretize his/her impressions of numbers both visually and verbally. As the existing schema is strengthened, the child may inherently recognize that one dot is the number one. For older children who are advanced learners, parents may show and question which is one dot and which is two dots, allowing the older child to point to the correct card. Furthermore, one could make learning more fun and interesting by using flash cards with the respective number of animals in place of dots.

Teaching Ven (three-year old) number sense

As a three-year old, Ven displays an absorbent and curious mind. This is evident in her speech and action. For instance, the child may ask many 'why' questions. Ven may also try out many other things and appear to be mischievous as it is the child's natural way of discovering things around her. As long as safety is not compromised, parents can and should encourage the child to learn and play freely. The following are activities and/or strategies enacted to integrate play with teaching number sense:

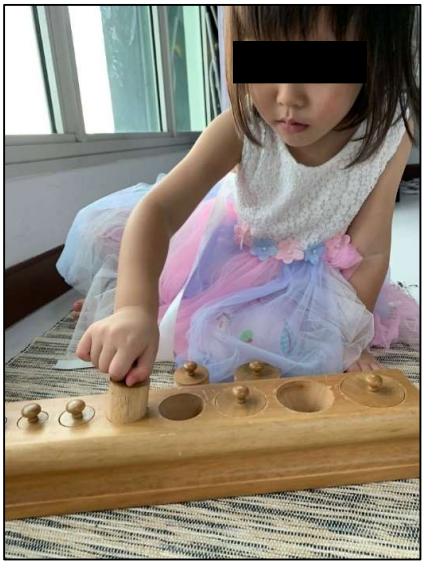
(1) *Playing mathematics prediction games*.
Children love any sort of games their parents can play with them. Hence, to arouse children's interest in number sense, parents may play a game of prediction with their children. For example, encouraging the child to predict the number of steps s/he can see the staircase, guess the number of oranges in a basket at a supermarket, or speculate how many people are wearing black in a restaurant. After the prediction activity, parents may reveal the actual number by counting the aforementioned items to the child. They may even ask their child to count along with them.

(2) *Playing memory games*.
This maybe in the form of a flash card showing number and dots or objects on the card. Patterns may also be introduced to enhance the difficulty of the game. A recommendation is to begin first with three cards to trigger the child's interest and gain his/her confidence. Then, increase the number to five, moving gradually to ten depending on how fast the child can pick up in learning. The numbers can be repeated from 1 to 10 and objects can be changed/substituted with other items. There is no need to rush the activity and one may repeat with three cards until the child is familiar before proceeding with an increased number of cards.

(3) *Using Montessori mathematics manipulatives*.
Montessori mathematics manipulatives have been found to be effective in mathematics

teaching and learning (see Laski et al., 2015, for detail). They are fundamental representations of mathematical tools that do not resemble real objects or possess irrelevant perceptual features. One example of a good set of Montessori apparatus is the Cylinder blocks (see Picture 3). It can be used to enhance a child's sensory awareness, and also to introduce the mathematical idea of size and proportion to the child as s/he will eventually be led to the concept of comparison of size. This activity can be conducted to allow the child to feel the depth and shape of the cylinder to make sense of which one to use.

The use of Number Rod, another Montessori apparatus, is another useful tool to introduce numbers to the child. Parents may form a rod stair, i.e., using one, two and three rods (each with a different length), and ask the child to follow in forming the pattern shown. Parents can count aloud the number of rods being used to form the stairs. Young children do not understand or easily interpret the meaning of symbols or tools used in helping them in problem solving (DeLoache, 2004). Hence, it is recommended that parents use these teaching manipulatives over a period of time in their mathematics teaching so that children can become more familiar and can better associate with the teaching tools with the concepts they are acquiring.



Picture 3. Ven exploring the use of Cylinder blocks

Picture 4. Using small blocks to make sense of number 1 to 5

(4) *Learning to write numbers 1 to 10*.
Identifying numbers 1 to 10 is a crucial milestone for early mathematics learners. Whether a putative innate number sense is required for successful arithmetic achievement as opposed to a pure reliance on domain-general cognitive factors remains an interesting unresolved question still being debated among the experts (Siemann & Petermann, 2018). With the acquisition of number sense, young children can better understand the basics of counting as this form of meaningful exercise allows them to draw connection between written numbers and objects. When writing, the parent should guide the child's hand in writing the proper form and encourage him/her to count out loud when writing. Writing or tracing numbers could be a useful guide for the early learners as it guides the penmanship of the child.

(5) *Learning mathematics through nature*.
When time permits, bringing children to nature and introducing real life mathematical concepts to them can help to contextualize their learning, e.g., counting the number of trees along a stretch of road or counting the number of petals in a flower. Parents should encourage their children to also count back the objects found in nature to their parents and, better still, to self-discover the connection between numbers and nature (see Watson, 1987, for detail).

Teaching Oli (five-year-old) number sense

Oli is not mathematically inclined and often chooses to avoid tasks related to mathematics (homework

and home-based worksheets). Rote learning through the use of worksheets often bores her to tears very quickly. As a result, her attitude towards learning mathematics is not very positive. However, the authors believe that all children can learn and also cultivate the positive habit of learning and liking mathematics. Hence, they believe it is necessary to engage the child through interesting lessons with fun and thrill, otherwise she would lose interest and impede his/her mathematics learning. When children are not engaged during mathematics instruction, it can affect their learning (Hanich, 2011). Therefore, the following are some of the authors' suggestions on how to make lessons relevant, meaningful and entertaining for Oli:

(1) *Counting and writing up to twenty.*
After having learnt the counting and writing of 1 to 10, the child can and should proceed to learn counting and writing numbers up to 20. There are many teaching aids including manipulatives commercially available that can be used in teaching numbers in the teens (also known as teens numbers, i.e., the numbers 13 through 19); one useful teaching aid is the teens board, where small blocks are used to formalize the numbers from 10 to 20. The child will be guided in counting the small blocks and putting them beside the respective numbers s/he sees on the teens board. Another good strategy or activity is tracing numbers that can be used to guide the child in writing the teens numbers. It can also come in form of a puzzle maze game, where one correct trace leads to another along a pathway within the maze. Seeking opportunities to count in our everyday life (e.g., counting the number of lift buttons from 1 to 20) could also reinforce the idea of counting. One may play a game of counting numbers backwards (i.e., 20,19, 18 …) to further reinforce the number sequence order. An example of this could be using a rocket toy to count down (e.g., "10, 9, 8, 7 … 5, 4, 3, 2, 1. Launch!") successfully before showing the rocket lift-off. For advanced learners, parents can ask their children to identify the numbers on a car license plate and ask if they can make 2-digit numbers, between 10 and 20, from the numbers they see on the number plate. This activity may excite the child and enhance his/her understanding of basic number combinations.

Picture 5. Oli preparing for her math task

Picture 6. Oli using teen board to learn numbers 11 to 15

(2) *Addition and subtraction.*
Preschoolers can attempt to solve easy problem sums through arithmetic operations of addition and subtraction of objects/items. For instance, at a supermarket, parents may ask their children to help them to pick up 4 oranges, 3 apples and 2 pears. Then introduce the term 'addition' as the child counts the fruits altogether. The final number is validated by asking her/him to count and say out the last number counted. Another example is that if parents have a fish-tank at home, they may encourage their children to actively count the number of fish food pellets before feeding the fish. Take 10 pellets and feed 4 pellets to the goldfish in the fish-tank. After feeding the goldfish with 4 pellets, the child can then count the number of remaining pellets. In this way, parents can reinforce the idea of subtraction by saying "Subtracting 4 from 10

leaves us with 6 pellets, or 10 minus 4 gives you 6".

(3) *Comparing numbers.*
The idea of bigger or smaller, more or less, more or fewer constitutes an integral part of understanding the number system. There are many activities parents can introduce to engage with their children in teaching the concept of comparison. For example, one can put 5 marbles of the same color in front of a child and ask him/her to sort them out into groups of 2 and 3. After which, parents can also ask the child which group has more and which has less. If the child is unable to compare, parents help by explaining the concept and showing him/her how to count and telling the child which group has more and which has less marbles of certain colors. Parents must remember to emphasize comparisons by using the terms 'more' or 'less'. For advanced learners, parents may introduce more colored marbles (up to the number the child is familiar with) and ask the child to group them by colors and compare in terms of quantity. When given more opportunities to explore and compare quantities of objects/items, children will learn to utilize two or more mathematical concepts to mastery (Gick & Holyoak, 1983; Son, Smith, & Goldstone, 2011).

(4) *Using clock or time to learn number sense.*
Understanding the concept of time is one of the important skills a preschooler should learn and a clock can also be used to teach number sense (Griffin, 2004). The parent may bring in a simple idea of time by telling them, "It is the morning and the sun rises at 7am. The sun sets at 7pm and there are 12 hours of day time" or "how long did you sleep during your afternoon nap?" The use of a teaching clock is useful to illustrate the concept of time: e.g., recognizing a clock face has the numerals from 1 to 12, and the shifting of the hour and minute hands moves in the clockwise direction. Also, in explaining that when the clock strikes 12, the hour hand moves to the next number and the next number in an hour's time is 1 and so on. Allowing the child to 'feel' the numbers inscribed on the clock face or spin the hands in the clockwise direction provides him/her an excellent opportunity to explore the movement of the clock hands and also to understand how time is read off the clock. For advanced learners, parents may show their children a specific time and ask them to show the same time or another time after resetting it. To incorporate the fun element in learning time, parents may have the activity timed to play as a game with their children.

Conclusion

Teaching number sense to young children or any preschoolers is by no mean an easy feat. However, it does bring along joy and with a calibrated approach, it can help to foster a strong parent-child bonding or relationship. The above list of suggested activities on how to teach are purely based on the authors' parenting and teaching experiences. Readers are reminded that the list of activities mentioned in this paper is non-exhaustive. There is no one-size-fits-all method or strategy and parents are strongly encouraged to explore many different ways to widen their child's perspective of numbers (or number sense). One may refer to commercially published teaching books, watch mathematics pedagogical videos for early learners and/or read relevant articles to gain more theoretical as well as practical knowledge on teaching methods. Real life experiences and hands-on approach via trial-and-error appears to be the most efficient and effective way to hone the teaching skills.

In this journey of educating young children, both parents (i.e., father and mother) must learn to complement and support each other. This is an essential factor because parenting burnout is a real concern. A suggestion is for the father to perform the play role while the mother to perform the teaching role or vice versa. This approach is most helpful and useful. It is recommended that parents should distinguish their respective parental roles so that the child is not confused by the "fuzzy" parenting so that s/he can easily associate the role of each parent when it comes to learning. As the saying goes "it takes the whole village, to raise a child". Hence, every family member should make a concerted effort in upbringing and teaching the young child in order to maximize his/her potential.

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