International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

A Child's Counting Skills: An Observational Study in Selected Villages Surrounding Maliko University

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Abstract: ***There is a growing awareness that many children from vulnerable communities are not stepping ahead in the acquiring of certain arithmetic skills such as counting. Counting is a surprisingly intricate process by which children call number values by name. This study investigated children ability to count from 1 to 5 and count on the number line. The research objectives were to ascertain counting skills of children aged 3-4 years ,establish if children aged 3-4 years can recognise numerals 1, 2, 3, 4, and 5 (thus 2 stands for two birds) and ascertain behaviours/ reasons contributing to ability to count or in-ability to count. The theory that was used was the cognitive science theory propounded by Barbara W. Sarnecka & Charles E. Wright. The research philosophy and design was pragmatism and exploratory sequential respectively. The sample was-thirty- four children who were mainly snowballed from various villages. The findings were that, some children could count both orally and using fingers, others could count but skipped numeral 4,others could count starting from 4 instead of 1, verbal counters were also found, others could count but not concentrate when pointing at the objects, some could count with objects, others were not able to count either with objects or without objects, some could count some numerals thus 1,2,3, others left within the process of counting while others exhibited traits of being shy. When a task was given concerning counting on the number line, some children could count on the number line, others could count from 2 to 4 and could skip 1 and 5, some ended at counting 1 and 2 only, others could not count at all, while others could say the number correct from 1 to 4 but pointing at different numbers. The study recommended stepping up counting activities in villages surrounding Maliko University and that further study should find out recognition, subtraction and addition skills of non-school going early children in villages surrounding Maliko University.***

Keywords: Counting, number line, oral/verbal counting, pragmatism, exploratory sequential

1. Introduction

There is a growing awareness that many children from vulnerable communities are not stepping ahead in the acquisition of early childhood education and care (UNESCO global education monitoring report, 2023) including arithmetic skills such as counting (this study). Therefore, this study investigated children's arithmetic skills such as counting (Early learning standards for Zambia-ELDs, 2016; MOE, 2013) and counting on a number line (Robert E. Reys, Mary M. Lindquist, Diana V. Lambdin, Nancy L. Smith,2012) in selected villages surrounding Maliko University.

Purpose of the study

The purpose of the study was to help children step ahead in counting skills.

Statement of the problem

Children counting skills form the building blocks for later arithmetic proficiency (Reys e tal, 2016 & Ilona Frisco- van den Bos, Evelyn H Kroesbergen & Johannes E. H Van Luit, 2018). Counting skills are indicative of mapping. Mapping skills are important precursor to arithmetic skills, and have been suggested to be of vital importance to arithmetic development. And yet there seems to have been no study to investigate non going school children counting from 1-5 and counting on a number line in villages surrounding Maliko University.

Objectives of the study

The objectives of the study were to:

1) Ascertain counting skills of children aged 3-4 years
2) Establish if children aged 3-4 years can recognise numerals 1,2,3,4, and 5 (thus 2 stands for two birds)
3) Ascertain behaviours/ reasons contributing to counting skills or non -counting skills

Research Hypothesis

Children are able to perform counting skills in villages surrounding Maliko University

Null Hypothesis

Children are not able to perform counting skills in villages surrounding Maliko University

Research Questions

1) What counting skills do children aged 3-4 years have?
2) How do children aged 3-4 years recognise numerals 1,2,3,4 and 5 (thus 2 stands for two)?
3) What sought of behaviours\reasons read to counting or non-counting?

Significance of the study

- To add to the existing literature as a way of reducing the knowledge gap in early childhood mathematics education such as, teachers of the young being able to provide both planned and spontaneous counting opportunities; teachers being able to point out the usefulness of knowing how many and encouraging the use of that knowledge.
- To help the children around Maliko University to step ahead in counting skills. Actually, parents were happy and asked the research assistants to be going in the villages to teach their children as they have no money to take children to school.
- To compensate governments effort in reducing innumerate levels in vulnerable communities in villages surrounding Maliko University.

2. Theoretical Framework

This study was anchored on the cognitive science theory propounded by Barbara W. Sarnecka & Charles E. Wright (2013). This theory states that, understanding what numbers are means knowing several things. It means knowing how counting relates to numbers (called the cardinal principle or cardinality); it means knowing that each number is generated by adding one to the previous number (called the successor function or succession), and it means knowing that all and only sets whose members can be placed in one-to-one correspondence have the same number of items (called exact equality or equi-numerosity).

Actually this theory acknowledges that in the Piagetian (1952) tradition, children understand numbers when they passed the conservation of number task around age five or six. For Piaget, the key number concept was equi-numerosity (sometimes called exact equality)-the idea that two sets have the same number of items, if and only if their members can be placed in a perfect one-one- correspondence**.**

3. Literature Review

A few studies have been conducted on counting in the past five years (Reys e tal, 2016 & Frisco- van den, Bos, Kroesbergen & Van Luit, 2018. According to Reys et al, (2016) as young children practice counting, they often say non-conventional sequences of number names. It is not unusual to hear a young child count one, two, five, eight, fifteen, twenty, six, hundred. Equally the same in the current study, some children said non-conventional sequences of number names such as, 1,4 and 10 which reflected the child's struggle to remember both the number names and their order to connect counting to cardinality. The quartet says that, this counting may sound strange, but it is perfectly natural. It reflects the child's struggle to remember both the number names and their order to connect counting to cardinality. Eventually, children may count apples, blocks, cards, rocks, stones, and twigs among others.

Additionally, Frisco- van den, Bos, Kroesbergen & Van Luit (2018) investigated whether fostering mapping (matching) skills is more efficient through a counting or number line training program. Frisco- van den, Bos, Kroesbergen & Van Luit (2018) differs with the current study in the sense that, the current study investigated counting skills of children in villages surrounding Maliko University so as to step up their counting abilities in line with vision 2030, UN agenda 2016, article 4 and African Union agenda 2063/2064. Actually, in Frisco- van den et al (2018), effects of both programs were compared through a quasi-experimental design, and moderation effects of age and socio-economic status (SES) were investigated. However, in the current study, no effects have been compared through a semi experimental design but an observation was conducted and parents assisted in ensuring that the children complied (Simon Herd, 2016). Furthermore, in the trio's study ninety kindergarteners were divided into three conditions: a counting, a number line, and a control condition. Pre-tests and post-tests included an arithmetic (addition) task and a battery of number sense tasks (comparison, number lines and counting). A battery of number sense tasks was also applied in the current study. Results from the trio's task showed significantly greater gains in arithmetic, counting and symbolic number lines in the counting training group than in the control group. But the current study has recommended that, there is need to go back to villages around Maliko Village to establish whether all the children could count now as a result of the tasks that were introduced to them. Although in the current study, there was no pre-test and they were only two tasks thus, counting and counting on a number line.

In Frisco- van den et al (2016)'s study, the number line training group did not make significantly greater gains than the control group. Equally the same, in the current study, most participants did not do well when it came to counting on the number line. In the trio's study, training gains were moderated by age, but not social economic status. And Frisco- van den et al (2018) concluded that, counting training improved numerical capacities effectively, whereas no such improvement could be found for number line training. But in the current study, it has been concluded that, the type of counters were diverse starting with those that could count orally, count both orally and with the use of fingers, counting but not concentrating when pointing at the objects, counting with objects, not able to count with objects, not able to count at all, counting some numerals thus, 1, 2, 3, not able to count sequentially, counting with confidence, leaving the session due to shyness, mentioning only numeral 04. Additionally, under the current study, when it came to counting on a number line, most participants could not count on the number line, others could recognise one numeral and count numeral 01 only on the number line, others could say the correct number from 1-4 but pointing at different numbers, not sequentially counting from left to right. The trio's interpretation was that only a counting approach was effective for fostering number sense and early arithmetic skills in kindergarten. However, the current study's interpretation is that, although most children aged 3-4 years in villages surrounding Maliko University are able to count orally with a few struggling but many of the participants are not able to count on a number line as suggested by Reys et al (2012). Reys et al (2012) suggested that, *children need to understand what is to be counted on the number line. Once the number line is clearly understood*, then the number line will provide a powerful model for counting on from any starting point A and counting to the right to B and counting back to the left starting from B and counting to A.

In line with Frisco- van den et al (2018) recommendation that, future research should elaborate on the parameters of training programs and the consequences of variation. This study recommends that, counting skills should be stepped up in villages surrounding Maliko Village; student teachers apart from teaching children in the demonstration school should also be offering services to the children in surrounding villages; parents should train their children on how to count prior to entering grade one and other counting strategies be stepped up such as counting on a number line in addition to elaborating on the parameters of training programmes and the consequences of diversity of knowledge gap among children.

Sanecka Barbara W & Charles E. Wright (2013) also investigated the link between cardinality and equi-

numerosity of numbers. The two found that children either understood both cardinality and equi-numerosity, or they understood neither. They suggested that, cardinality and equi-numerosity (along with succession) are interrelated facets of the concepts five and six, the acquisition of which is an important conceptual achievement of early childhood mathematics education. In fact, Sanecka and Wright (2013) literature reviewed highlighted: firstly, Piaget's question (Are there the same number of flowers and vases? while the current study highlights questions such as can children 3 to 4 years count from 1 to 5 and count on a number line? The Sanecka and Wright review focused on abstract & explicit knowledge that the child could articulate; Secondly, Carey's theory that,

Children 1st learn about particular number words, later categorise to the superordinate category of numbers, counting list-one, two, three among others learnt as place holder. The study did not investigate counting in villages surrounding Maliko University. The current study has brought out the following aspects: Counting occurs only: 1.when adults support children as they are counting. It require language, ability to count a set of objects (or even sounds or gestures).3. It involves the counter fulfilling five principles: one-to-one correspondence, stable number word order, cardinality (the last number word in the count represents the numerosity of the set), order irrelevance (objects can be counted in any order), and abstraction (items even if dissimilar can be counted as a set, or a collection of objects.

Additionally, OguZ Serdar Kesicioglu (2021) investigated counting skills of pre-school children. The aim was to examine the counting skills of children in pre-school period. The study was planned according to survey model .108 children aged 60-72 months attending kindergarten were involved. In Kesicioglu (2021) study, counting skills test was used. The conclusion was that, pre-school children possessed good levels in the skills of rhythmic counting, stable order, counting the next number, abstraction, cardinal number and recognizing numbers. This study was done in Turkey.

The Turkish school curriculum (2013) had contents such as the counting-related achievement, "Count objects", has the following indicators: „*Count up/down rhythmically one by one, denote as many objects as represented by the specified number, tell how many objects are counted, tell the ordinal number and tell the number that comes before and after a number among numbers up to 10*. That study, did not aim at examining counting skills of community children aged from 36 to 48 months. The current study uses an observation model thus written observations, drawing or attempts of writing, pictures of creations and videos. The conclusion in this study is that counting skills of children varied. Furthermore, the current study was done in Zambia where there seem to be no focus on non-school going children where early childhood mathematics provision is concerned. The Zambian school curriculum (2013) has the following specific outcomes*: count orally up to ten (10) objects, identify number values 1-5, use numerals 1-5 to symbolise quantities of objects*. And the Content is tabulated as follows: Knowledge: 1. Using *concrete objects to count up to 10 (employ songs, rhymes, games.* 2. *Recognising number values of 1-5*. 3. *Recognising of number symbols/numerals 1-5.*; Skills: *representation of quantities by numerals, using numerals 1-5 to represent quantities of objects, communication through counting and identification of number symbols* Value: *awareness in symbolisation of quantities, awareness of numeration system and number order and team work through cooperative learning*.

Lastly, Agness Mando Banda (2018) studied teacher education and the teaching of subitizing in early childhood centres in Lusaka urban, Zambia. The aim of the study was to examine the extent in which ECE teacher education mathematics programmes prepare early childhood teachers for teaching subitizing to young children in ECE centres in Lusaka. This study made reference to national documents, qualitative and quantitative approaches were used, Semi-structured key informants interviews (KIIs), FGDs meetings, questionnaires and documents and records analysis was used as data collection methods. This study found that, Zambia Education Curriculum Framework and the National Numeracy Framework, does not state the topic subitizing; all text- books, reference materials used at teacher education level and Early Childhood Education teacher in-service training, ECE centres do not mention the term subitizing; educators asked thought subitizing and counting thought as one and the same, the topic is not planned for and had no time allocation. That study recommended that: content of mathematics curriculum, all text books, reference materials and the NNF should include and start with the concept of subitizing. Mando (2018) recommendation especially on starting with the concept of subitizing differs from the current studies recommendation in the sense that, in the learning progression of number, children first learn classification, followed by patterns, then conservation and group recognition (subitizing) later (Copley J, 2010 & Reys et al, 2013) . Such a sequence is then followed by one-to-one correspondence, comparisons, then connecting groups with number names, including oral and written cardinal and ordinal numbers, counting forward and backward, skip counting, establishing of bench marks of quantities such as 5 or 10 and lastly place values. The focus of Mando (2018) was not on counting by learners but own argument was on the concept of subitizing presumably missing and yet subitizing is taken as an early number development concept which in other literature is taken as group recognition (CHAu Module,2011 and 2018). In Mando's article document classroom observation and principles of researching with children were missing, the sampling procedure, inclusion and exclusion criteria were equally missing and the study did not discuss the findings. The current study discusses many skills of pre-school children related to development of number such as counting and counting on a number line, thus significantly contributing to literature.

In Kesicioglu (2021), for the purpose of discussing many skills of pre-school related to counting and counting on a number line , answers for the following questions were sought; (1) *at what level are the rhythmic counting skills of children aged 60–72 months? 2) At what level is the counting down skills of children aged 60–72 months? 3) At what level is the counting on skills of children aged 60-72 months? 4) At what level is the stable-order principle of children aged 60-72 months? 5) At what level are the skills for telling the*

next number of children aged 60–72 months? 6) At what level are the skills for telling the previous number of children aged 60–72 months?7) At what level are the skills related to the abstraction principle of children aged 60–72 months? 8) At what level are the skills of the order-irrelevance principle of children aged 60–72 months? 9) At what level are the subitizing skills of children aged 60–72 months? 10) At what level are the skills regarding the ordinal number principle of children aged 60–72months?11) At what level are the skills regarding the cardinal principle of children aged 60–72months?12) At what level are the skills for recognizing numerals of children aged 60–72 months?

While in this study, the checklist focused on the following aspects:

1) Did the child retrieve the words?
2) Did the child start with an accurate count and when that was exhausted did the child move on to a random number sequence and occasionally used non-number words in their sequence?
3) Did the child have problems articulating words themselves or problems with the sequential nature of the task?
4) Did the child have difficulties in making one-one correspondence between their gestural action and verbal count?
5) If your answer to 4 is yes. Indicate any of the behaviours that you noticed: Double counting, skipping over objects, continuing to count after the objects have been counted for, or stopping counting before all objects have beenconsidered.
6) Did the child recount all of the objects or select a random number after you asked, "How many?"
7) Did the child have problems with the actual concept of number (thus not getting the three- ness of three)?
8) Did the child count for example, one, two or three effectively?
9) Did the child shift attention serially from object to object?
10) Did the child often keep track of their counting by use of gestures?
11) Which finger was the child using to count?
12) Describe the manipulatives that were used by the teacher to teach counting?

4. Methodology/ Procedure

Participants included 34 non-school going children. Their age ranged from 3 to 4 years .Some children could speak Soli while others spoke Nyanja with a few speaking other languages such as Bemba, Lozi, Tonga among others. The children were recruited through a snowballing method. The researcher asked one parent who later directed the researcher to another parent who had a child within the age range under study while other children were searched for by the research assistants for children in the specified age range. The children were observed in the comfort zone of their parent's homes. Research assistants were paid nothing as this was part of their continuous assessment. No question was asked about socio-economic status, tribe, and educational background. Participants were residents in villages surrounding Maliko Village. Permission was sought from their parents as it can be evidenced by some of them seen watching over their children as children were answering questions and others seen helping the researcher in asking questions.

The researcher introduced own to the mothers of the children. Then in turn the mother introduced own to the participant. The researcher sung some songs, for example, "cuula mumenshi" with them. The aim of the song was to get acquainted to the children. The first activity, the researcher started with was greeting the child, asking for the child's name, asking the child's age, asking the child, if own can count to five. The purpose of this activity was to make the participant comfortable, see patterns and plan age-appropriate activities. An example, on how the observation and an interview were conducted is given below:

Video transcription
Researcher: Count this numbers "penda ma number aya".

Child fails
Researcher arranges numerals in a seemingly order for the child

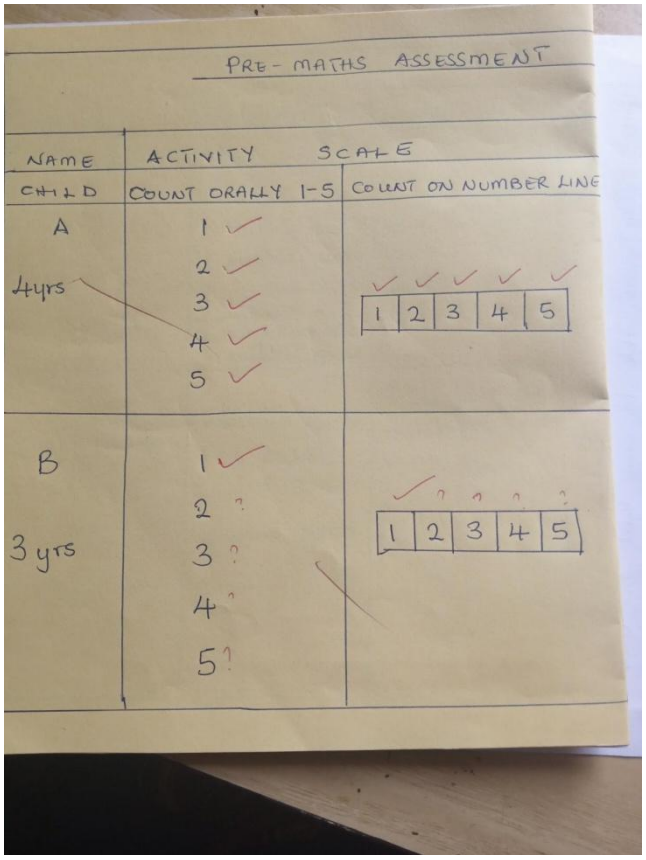
Child counts. First from left to right then right to left

Researcher: Teacher says addition questions orally (for example, 1+1=, 2+2=. Child verbally adds Researcher: Teacher says subtraction questions orally (2-1=). *Child fails to answer.*

Researcher: Teacher uses fingers and instructs children to observe "*yangana kuno*"as own is performing the act of subtraction the child subtracts

The current study found that, child A (4 years) was asked to count orally her fingers and then later asked to count orally, of which she was able to do correctly. Child B (3 years) was only able to count number 1(one) the rest of the numbers were said in a jumbled way and the numbers 2 and 4 were not mentioned.

Count on a number line
The researcher started by asking the child if own can count on a number line. The purpose of this activity was to gain insight into how a child thinks about counting and provide opportunities to change the learning environment to promote growth and development. Child A (4 years) was able to count on the researcher's number line very clearly and also counted stones correctly although counting was from right to left. Child B (3 years) was only able to count number 1 (one) the rest of the numbers were said in a jumbled way and the numbers 02 and 04 were not mentioned. Below is the sample of the work



Sample of children's responses

5. Data Analysis

Data analysis was analysed using themes, using frequencies and percentages. Themes were organised according to research objectives.

Data presentation, analysis, findings, conclusion, recommendations and innovation Counting up TO 5

#	Tally marks	Frequency	Comments
0	/		C1: the child was unable to count number 1-5
1	/	01	
2			
3	/	01	C 1:The child could count numbers from 1-5 though jumped some numbers
4			
5	//////////////	14	C1: The child was able to count 1-5 using his finger

01 could not count. He was only able to express himself in Nyanja. This finding is similar to what Cunningham Bob (2014- 2023) and Faith Sadler (2009) talked about. According to Cunningham 2014, to many people counting seems so basic that many people do not realise how much goes on it. Actually counting involves many small but critical skills, together; these skills are sometimes called number sense. This is the ability to understand what numbers are and how they work without thinking about it. Cunningham 2014-2023 gives an example that, some children with number sense naturally understand concepts like amounts and what more and less mean. They know there are symbols for numbers, like 5 means five things. Therefore, to count well, such children need to learn and remember those symbols in order and remember, such children require a skill called working memory. Families and teachers can work together to come up with a plan on ways to help a child come better at counting at home and at school.

Innovation from this finding

The plan should have the following steps: take a closer look at what's happening and take notes on what you are seeing by reflecting on this questions, Is counting the only challenge? Are there signs of anxiety or frustration? The other way is to point out children's strengths, and remind them that other children also have difficulties as well.

Actually Sadler (2009) proposes use of other strategies for pre-counters such as playing matching and sorting games, creating matching sets with their fingers, where the traditional counting songs and rhymes are not working response shaping (start with simple rhymes or routine for saying 1,2, 3 then move on to big numbers) can work.

Teachers should help by modelling for children what the term *each* means. Children might be asked to give each baby a bottle in the dramatic play area, give one bell to each child at music time, or put one napkin beside each chair in preparation for a snack.

For children responding with a number word sequence but without tagging each item, teacher can help children by having them pair each number words with an action or object (for example, counting while clapping hands, patting legs, or jumping). Furthermore, the teacher can embed instruction in typical classroom routines and activities (for example, have children pretend to take three bites of porridge or pound their fists upon listening to a story). Let children slide crackers from one side to the other, push bean bags out of the circle taped to the floor.

The teacher can model cardinality by repeating the final number while moving his hands in a circular motion (to encompass the whole grouping) and ending with an arms-out gesture: 1,2, 3, three al together. The teacher can start pairing instruction on procedures with questions and comments that encourage children to problem solve and to talk about their reasoning. Questions like how about if we spread these things out? Now how many are there? How about if you start counting at a different place? Do you think we'll get the sameanswer?

For children focusing on the final number –tag and often overlooking their counting errors, teachers can help such children by teaching them strategies for keeping track of the items already counted for example, choosing a starting point that is easy to remember, lining up the objects before counting them, or pushing items aside as they counted into a pile. Strategies to improve reasoning may include judging a puppet counting and identifying what is wrong.

For children who always think the answer to how many is the largest number in the counting sequence, the teacher must take the children away from memorizing the procedure of

counting to a more flexible conceptual understanding of quantities and how counting may or may not (if not done correctly) help to determine that many ness. For example, letting the puppet say the number words in wrong order (2,4, 6, 3 for a set of four),asking questions that prompt a lot of counting (I spy a person with six pockets on their pants. Do you know who it is?),provide highly motivating activities, where children are so invested in getting an accurate answer that they are eager to check by counting again, give the children a puzzle.

Lastly, for counters, extra work on a problem solving game named, how many are hiding can be used as well as activities to do with spontaneously recognize larger sets can be given to children.

01 child could count only 1 and 5 and skipped 2, 3, 4. This child knows some number names but not necessarily the proper sequence. This finding is similar to what Reys et al 2012 said. According to Reys et al, 2012, *a child using rote counting knows some number names but not necessarily the proper sequencing*. It is therefore recommended that, such a child should spend much time on the stable-order rule. This is a principle that states that, *the number-name list must be used in a fixed order every time a group of objects is counted* 14 children could count up to 05. But this counting was done orally. This finding is similar to what Noel & Rousselle, 2011 cited in (Ilona Frisco- Van den Bos, Evelyn H. Kroesbergen & Johannes

E. H Van Luit,2018) said that, reciting the counting sequence may help children understand the cardinal value of number words, there by realizing that each number word relates to an exact quantity using bottom-up processing. In the bottom up processing the individual stimulus, in this case the quantity or number is used to construct an understanding of a system as a whole, in this case a system of numbers and their quantitative relations such as bigger and smaller numbers. But Van den Bos et al (2018) sentiments are different from Linda M Platas (2017). Just as Linda (2017) admits on one hand that, *unlike knowing which of the two groups is larger, or adding one object to a set of objects makes the resulting set larger, counting requires the support of a more knowledgeable other, whether that person is a parent, caregiver, teacher or peer. The reason is that counting requires language. To be specific it requires number words. On the other hand*, Linda (2017) argues that, For *century's children's rhymes, games, and songs have set the stage for seemingly effortless acquisition of verbal counting. Young children happily sing songs in which ducks disappear and monkeys fall off beds. But counting is not just all about knowing the number words. It requires the ability to count a set of objects (or even sounds or gestures). It also involves five principles namely, one-to-one correspondence, stable number word order, cardinality- the last word in the count represents the numerosity of the set, order irrelevance (objects can be counted by any order) and abstraction-items, even if dissimilar can be counted as a set, or a collection.*

Therefore, this study recommends that since counting is a foundation to later mathematics development such as understanding quantity, manipulating quantities (like adding, subtracting, or fair sharing), children need abundance of counting experiences such as the following innovation:

Innovation from this finding

- Engaging children in meaningful activities (For example, encourage children to count as many times as possible, quickly or slowly, loudly or softly, steadily or in a stop/start fashion; and in isolation)
- Providing both planned and spontaneous counting opportunities such as classroom transitions-washing hands, setting tables, sharing of blocks among others.
- Letting the child count first then ask how many later
- Integrate subitizing activities with counting activities (for example, invite children to subitise dice or finger patterns before asking them to confirm the quantity bycounting)
- Pointing out the usefulness of how many and encouraging the use of thatknowledge

This study by the researcher observing some videos found that, some children were having difficulties in making one-to-one correspondence between gestural actions and verbal count as a result of double counting, skipping over objects, continuing to count after they have been accounted for, stopping counting before all the objects have been considered.

6. Innovation for this finding

For children experiencing such difficulties, teacher should separate out the gestural action and the verbal count. This will allow the child to count as the teacher gesture or vice versa. Furthermore, as the children gain increased confidence, they should practice doing both elements simultaneously, initially just with quantities to three, gradually extending to larger quantities. Children should be encouraged to move the objects as they counted to ensure objects were not counted twice.

The researcher also found that, in some instances the overall task was too difficult such as counting on the number line. This counting placed considerable demands on working memory of the children (Passolunghai, Vercelloni & Schadee, 2007 in (Austrialian Primary Mathematics Classroom/journal-APMC, 2015). And yet this memory system had limited storage space, which could not be overloaded by the complexities of the counting process.

Innovation for this finding was to reduce the memory demands of the task to non-essential aspects, for example by placing the objects in a line prior to counting

Furthermore, this study found that some children had problems to shift attention serially from object to object. APMC, 2015 said that children often keep track of their counting by the use of gesture. Therefore, for children with such problems, the use of physical touch reduces error.

Additionally, children with word retrieval difficulties may express their understanding of cardinality by showing the pertinent number of fingers rather than expressing their understanding in words. Butterworth (1999) argued that fingers may be a bridge between a child's innate counting ability and the development of mature countingsystem.

Moreover, brain imaging has shown that, the part of the brain that is activated for finger movements is very close to that used for number. Damage to this part of the brain can, amongst other things, result in finger agnosia, and the inability to distinguish each finger individually without visual cues. Training children to improve their ability to differentiate between their fingers as well as finger dexterity and strengthening has been shown to improve a number of numerical tasks including finger counting. Therefore, fine motor skills should be incorporated into these innovations in surrounding areas in Maliko Village.

Lastly, it was established that parents had long belief in the usefulness of manipulative materials to practice one- to one correspondence. For some children, however, the manipulatives themselves maybe so rich with interest that they distract from the counting task. Rich manipulatives may put pressure on working memory system as children focus on the irrelevant aspects such as colour, movement or possibility of play. Rather than seeing the objects as symbolically representing a set of items, they may persevere on the superficial characteristics of the individual objects making a meaningful count impossible (Petersen & Mc Neil, 2013). Therefore, in the new innovation, counting objects should be small wooden cubes as these are easy for children with fine motor difficulties to grasp.

7. Findings on counting on a number line

#	Tally marks	Frequency	Comments
00	//		C1: The child had problems on number identification C1: the child was unable to arrange the numbers in ascending order
01	///		C1, 2, 3: child only managed to identify numeral 1 and failed to arrange numerals in order. .C3: she managed to answer all questions except for the number line which had challenges on due to the negative and positives. She was not shy scared of talking but answered very well even on what she does not know. She opened up to say ""I don"t know if this is 1 or what because of a negative sign."
02	/		C1: the learner was unable to identify some numbers. after showing him a number line to identify he said he does not know what it is
03	/		The child had challenges in identifying and placing objects
04	/		C1: I observed her in counting o a number line, on this one she failed to count number two, the remaining numbers she was able to count. The girl was active and live though she failed to recognise number two.
05	////		C1:Identified numerals from 0 to 5 because of being exposed to numerals at school; C2: child had difficulties in identifying number zero and ended up saying number 10 because of no exposure to the number line otherwise the child had had no problems because was exposed to numbers and therefore he had counting skills C3: this child was able to respond to the questioners without much challenges, he was able to understand English language which contributes a lot for him to answer all questions correctly. This made my interview or rather research very interesting. C4: the girl was hesitant at first then complied and gave the expected results. She managed to recognise numbers 1-5, count on the number line was done.

01 participant had challenges in both thus counting up to 5 and counting on a number line. One boy was able to place on 1, 2 and 5 but omitted 3 and 4. The comment was that, *the learner had challenges in identifying the numerals and place value*

From the data given in the table, it seems most of the learners failed to count on the number line. And yet according to the theory of cognitive science, understanding number means knowing how counting relates to number. This finding is similar to what Eduarda Van Klinken and Emma Juleff (2015) wrote about. Klinken and Juleff (2015) wrote that in their classroom, *they were concerned that after 12 months of their best efforts to reach counting skills to 5-7 year olds, only 30% of the children could correctly respond to the following simple counting tasks: forward number counting from one, how many blocks are there (five), give me eight blocks (from a pile of 12).* Furthermore, *Reys et al (2012) also said that, many children find it difficult to count backwards, just as many adults find it difficult to recite the alphabet backwards.* But unlike the duo's sample size which had many of the children not only with communication, fine and gross motor, limited working memory, social or emotional difficulties, short attention spans, reduced conceptual understanding challenges, the current study wonders as to what could have posed the challenge although those that were already in school had no challenges apart from one participant who had problems counting zero and instead counted it as 10. Maybe, it is because the use of calendars, calculators and number line has not been one of the counting strategies in the main education stream. Agreeing with the researcher's perception (Reys et al, 2012), says that, in a number line task, a child places a target number on an empty number line bounded by the begin and endpoint marked on either side of the line- a top down approach in which the number range has been framed and individual units need to be placed within this framework. To use number lines in number tasks, children need to be able to relate a number to the corresponding quantity and consequently realise that a number obtains its position on the number line through its quantitative value. This is in line with the theory of cognitive science which says that, *understanding number also means knowing that all and only sets whose members can be placed in one-to-one correspondence have the same number of items.* Typically, young children make non-linear placements, adhering to a logarithmic or power model of placements.

Awareness of number line placements may be interpreted as a child's ability to map between symbolic numbers and non-symbolic quantities (Kolkman et. al, 2013). The symbolic numbers, in this interpretation are the numbers to be placed on the empty number line, and the non-symbolic quantity is represented as the continuous space between the extremities

of the number line.

The trio actually emphasises that the training of number line placement has received growing interest in the past few years. For example, playing numerical linear board games, in which linear ordering of numbers was emphasised has repeatedly been reported to improve successfully number line awareness and thereby facilitating mapping although in other literature thus Rey's et al (2012), it was reported that matching (mapping) can be done without counting. However, placement of numbers along the continuum of a number line may be seen as a form of visual imagery of number information, a pre-requisite for successful acquisition of more complex procedure skills needed in advanced mathematics. Furthermore, number training has also been demonstrated to enhance arithmetic performance in a study among kindergarten children, but there was no transfer effect to other measures of number sense.

Innovation after this finding

Instruction in counting should include practice counting backwards as well as forward because this will help children establish sequences and relate each number to another in a different way.

Children need to understand what is to be counted on the number line. Because a number line is a

1) Powerful model for counting on from any starting point A and counting to the right to B. and counting back to the left starting from B and counting to A
2) A number line never ends, so if a different part of the number line is shown, then counting back 5 from B would model a different computation
3) Since both counting on and back are important skills and children will encounter zero and negative numbers, it makes sense to introduce them.

Other models such as Calculators, calendars, thermometers, losses and gains, pebbles in the bag and elevators among others should be used to teach counting. This is because research suggests that young children are capable of understanding negative numbers far earlier than was once thought (Kilpatrick et al, 2001)

A diagnostic observational assessment form should be developed. This can be used to record and analyse children's counting activities.

Task/ tasks

Example: Count forward from 1

Verbal count	Comment
• Verbal number count • Count correctly to------ (e.g 5)	1,2,3,4,5-,7,8 ,(note implies thinking)
• Skips or inserts number word (e.g 6) • Random number words/adds non-number words (e.g letters) (random from 9) • Child assisted by virtual cues (e.g finger counting, neading, tapping by a child or teachers)	

Other impacting elements related to the task			
Gesture	Comments	Attention:	Comments
Describe gesture (e.g touches objects, points only, eye points, other body movements-rocking, head nodding) which hand was used?)	Example: nodes head as counts	Cannot focus on tasks (e.g distracted by objects or environment)	Good focus
Organisation	Comments	verbalisation	comments
Describe organisation (e.g organises materials prior to counting, starts from one end and moves to the other, counts objects adjacent to each other	/	Describe verbalisatiion (e.g counts out loud, sub- vocalises, no lip movement, articulation	Three=”free”
Fine/gross motor skills:(e.g drops/ difficulty handling objects	comment	other	comment

Suggested intervention (example)

- Use finger counting/ number line as prompts
- Practical mathematics activities in range of 1-5
- Regular counting practice insongs/fast/fast slow etc
- Speech therapists to assist with /th/ articulation

Counting analysis adapted from Eduarda Van Klinken & Emma Juleff (2015) ***They still can't count: Assessing and Supporting Children's counting difficulties in early years of schooling****. Glenleighden School, Qld accessed on 07/02/2023*

In addition, since counting on a number line had given children challenges, it is recommended that, during a number line task, a child should place a target number on an empty number line bounded by the begin and end points marked on either side of the line.

Teachers need also to be aware that, to use number lines in number tasks, children need to be able to relate a number to a corresponding quantity and consequently realize that a number obtains its position on the number line through its quantitative value.

Teacher should further note that, young children make non-linear placements, adhering to a logarithmic or power model of placements, while older children show a more linear pattern of number placement, with equal spacing between numbers of various sizes (Paladino, 2011 cited in Ilona Frisco-van den Bos, Evelyn H. Kroesbergen and Johannes E. H Van Luit (2018).

Acknowledgements

The author would like to acknowledge in-service teachers for April intake 2021 and December, 2022 who helped in Data collection. Own would also like to extend gratitude to the Dean school of early childhood studies for authorising the

study verbally. Lastly, own would like to thank MOE for recognising own to be part of the research team for mathematics education.

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APPENDIX SAMPLE OBSERVATION CHECK LIST

Name of the observer----------

Name of the child----------

Task----------

Child retrieves the words.

Child start with an accurate count and when that was exhausted move on to a random number sequence and occasionally used non-number words in their sequence.

Child has problems articulating words themselves or problems with the sequential nature of the task

Child has difficulties in making one-one correspondence between their gestural action and verbal count

a) Indicate any of the behaviours noticed

- Double counting
- Skipping over objects
- Continuing to count after the objects have been accounted for.
- Stopping counting before all objects has been considered.

Child re-counts all of the objects or select a random number after you asked, "How many?" Child has problems with the actual concept of number (thus not getting the three-ness of three)

Child count for example, one, two or three effectively Child shift attention serially from object to object

Child often keeping track of their counting by use of gesture The finger that the child was using to count

Describe the manipulatives that were used by the teacher to teach counting

Total Score----------