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Number Recognition Skills of Non-School going Children: A Pilot Study of Children in Villages Surrounding Tipangeni University, in Zambia

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Abstract: ***This study investigated number recognition skills of thirty-four (34) non-school going children around Tipangeni University in Zambia. Number recognition is a skill of recognising different numbers by their names, by the way they look and by matching them to their representative quantities. The time when it is developed is not well established. An observation checklist and open ended interview questions were used to establish number recognition skills of non-school going children in villages surrounding Tipangeni University. The theory that was used was number identification: a unique developmental pathway in mathematics by Helen Cramman, Sara Gott, John Little, Christine Merell, Peter Tymms and Lee T. Coppings. Mixed methods were used in particular exploratory sequential. The study conducted three pilot studies for triangulation purposes. Among triangulation purposes were, cleaning-up the observation instrument, interview guide and processes of data analysis. In pilot study number one (01), it was found that, the way children recognised numbers varied, numeral two was recognised by most children and numerals five and three were least recognised by children. While in pilot study number two (02), it was found that, some children showed hesitation to answer, scared, gave correct answers, failed to arrange numerals from 1-5, some failed to perform both skills thus arranging and identification, others arranged and recognised but failed to write while others managed to identify the numeral one (01) only and in pilot three (03) it was found that, 04 children were able to recognise numerals from 1 to 5, 06 children were not able to recognise numerals and 01 child was partially able to recognise numerals. The study recommended that, the government should prioritise investing in ECE as this would help children including those with disabilities, vulnerable children to be exposed to new technological advancements, work with public private partners to continue implementing free education policy even at ECE level, address challenges faced by children by improving the existing structure in schools and building modern structures to suit their abilities and need. Children should be put in school; the parents should stand as tutors or as a private teacher in the early childhood stages of their children. Teachers should give more offline and online activities and employ different methodologies (songs and rhymes with number flash cards, play, dancing, and games-finger games among others) to address changing needs of the child. Further study, should investigate children's ability for them to be deemed as excellent number recognisers and the effect of non-numerate mothers on the development of children's number recognition skills as well as ways of teaching number recognition to children with special needs.***

Keywords: Number recognition, number identification, number naming, number writing, and number arrangement

1. Introduction

The National Council for Mathematics (NCTM, 2000) and United Nations educational Scientific Co-operation (UNESCO, 2023) recognises number recognition as one of the key mathematical skills in developing the concept of number. Number recognition is a skill where children learn how to recognise different numbers by their names, by the way that they look and by matching them to their representative quantities as well as writing numerals. According to Twinkl (2023), it is developed at the same time when numbers are formed and when children start counting. But this depends on the type of counting that is emphasised. Number recognition itself is made up of four main individual skills such as identifying numbers (children learn how to correctly and automatically recognise numerals between 0 and 9), naming numbers (children being able to recall the name of a number upon seeing it in either numerical form or as a quantity), matching numbers to their representative quantities (children learning how to look at a quantity of objects and matching this quantity to the correct number), writing numbers (children being able to learn how to write numbers, both as words and in their numerical forms). These number recognition skills help early learners to develop fundamental skills that they will need to progress in when they reach ages 5-6 and everyday life. And yet there seems to have been no study in villages surrounding Tipangeni University. The steps to introduce the number recognition skills to children are many. These includes teaching children to recognise numbers by using fun stories or chants for each number, practising sky-writing the number in the air, drawing it in sand or other messy play substances, making numbers in craft activities, teaching the concept of counting, memorizing the numbers, recognizing the numbers and interacting with numbers among others (Manpreet Singh, 2022). If children are not able to recognise numbers, they may struggle to complete even basic mathematics problems, add up their grocery bill and form/write numbers among others. However, it is quite difficult to say when children stop learning about number recognition as larger and larger numbers will in-corporate into mathematics lessons as they advance. Therefore, this study investigated whether children could i) identify numbers. ii) Name numbers. iii) Match numbers to their representative quantities. iv). Write numbers

Purpose of the study

The purpose of this study was to come up with an innovation (s) of teaching non-school going early children number recognition.

2. Theoretical Framework

The theory that was adapted was what Helen Cramman, Sara Gott, John Little, Christine Merell, Peter Tymms and Lee T. Coppings (2018) came up with. Helen Cramman et al (2018) say that, there appear to be a single, uni-dimensional pathway in learning to identify number symbols with discrete difficulty stages. Actually on examination of differential item functioning, this pathway is invariant across gender, country, socio-economic background, first language and across the first year of schooling. This theory further states that, almost all children make progress along the pathway during the year and recommends that a number identification scale may be a universal ruler by which all pupils could be assessed. This article investigates non-school going children's ability to recognise numerals-identify numbers, name numbers, match numbers to their representative quantities and write numbers in line with Helen Cramman et al (2018) & UNESCO (2023). According to UNESCO (2023) & Helen Cramman et al (2018) there is one single pathway to learning number recognition thus through play (Tanja Mcilroy, 2022) and universities should work with non-going school going children to improve their number recognition skills, need to plan and teachers/lecturers/parents should be put at the centre of the plan (UNESCO, 2023) and execution of the plan. Further there should be a number identification scale ranging from 0 to 4 with indicators of number recognition thus number identification, number naming, number matching with representative quantities and number writing. The scale level descriptors should be 0-fails all the indicators of number recognition, 1-Child does one skill, 2-child does two skills, 3-child does three skills and 4-child does all the skills.

Significance of the study

The significance of this study will be that, non-school going children will learn to identify numbers, name numbers, match numbers to their representative quantities and write numbers. This study will also contribute to the existing knowledge in Zambia on learning how to recognise numbers that was started by Nakawa et al, (2020) & Getrude Chimfwembe-Gondwe (2023). Nagisa et al (2020) group of researchers explored on this aspect among grades 1, 2, 3 and 4 in Zambia while Chimfwembe-Gondwe (2023) explored counting skills among non-going school children in villages surrounding Maliko University and not number recognition skills in villages surrounding Tipangeni University. Both Nagisa et al (2020) & Chimfwembe-Gondwe (2023) did not inquire the number recognition skills among 3 to 4 year olds. And yet according to TwinKl (2023) it is mentioned that, children should start learning about number recognition in their early education, in preparation for advanced content when they are 5 to 6 years old. Ibid also say that, children usually learn about number recognition at a similar time to when they are learning about number formation and how to count. Furthermore, this study will compliment MOE (2018) 's effort which is already rolling out the CATCH –up programme in about 5000 primary schools (Vvob, 2023) which are situated in environments where non-school going children are found as well.

3. Literature Review

Janner Simarmata, Tonni Limbong, ARS Tambunan, Mariati Purnama Simanjuntak, Riswan Limbong, Agung Purnomo, Riesta Devi Kumalasari, Fatkul Anam, K Khoifulloh, Khairun Nisa, Yen Aryni, Oktaviana Nirmala Purba, Fricles Ariwisanto Sianturi, Pilippus Targan, Efendi Napitupulu (2018) did a study in Indonesia on Multi-media of Number recognition for early childhood using image object. Their findings were that many children aged 05 years are currently challenging to comprehend the mathematics learning, especially the counting (Getrude Chimfwembe-Gondwe, 2023). Although Chimfwembe-Gondwe (2023) study was on non-school going children aged 3-4 years. According to the 10 researchers, they further found that, children assumed that mathematics is a disliked subject, while most of the aspects in the daily life require the ability to count while this current study show that some children had no challenges and others had challenges and that, parents would like their children to learn how to recognise numbers. Janner Simarmata et al (2018) recommendations were that, *in early childhood, a mathematics learning activity should be in a fun atmosphere in learning* while the current study recommends that, number recognition should be taught to all children for the country to attain vision 2030 whose focus is on Zambia becoming a prosperous middle income country. In fact, Janner Simarmata et al (2018) emphasised that, *to know numbers, numbers need to be presented creatively by using multimedia so as not to bore children*. But this study emphasises that, to be able to recognise numbers, a child should use basic language of counting, understand the entire process of counting, link terminology of numbers, own numerals and appropriate quantities, taking zero into account too, include a step of steps or a proper set of counting principles, explore groupings, recognise groupings faster, learn in various places, use classroom exercises-digit formation up to 20, matching the digits with their names and exact quantity up to twenty objects, comparison of small quantities, knowing the particular sequence of numbers, thinking mathematically, improving language and terms related to number recognition-use external help-offline activities (for example, songs and rhymes with number flash cards, everyday counting) and online activities (games, apps downloaded from numerous applications on play store and Appstore), link real life activities with learning processes among others (Singh, 2022). According to Janner Simartha et al (2018), the application of number recognition for early childhood is equipped with sound to assist the children in pronouncing the numbers. By using the computers the children can recognise the number 1 to 10 increased by about 37%. However, the current study did not use any of such tools but relied on critical observation as children identified numerals and placed them on the number line and as they responded to interview questions posed by research assistants as well as a set of instructions they responded to. Janner Simarmata et al (2018) recommendations were that, teachers also need to get training to use the computer as a medium of learning as an alternative in educating children to recognize numbers while this study is recommending that parents should be trained on how to teach number recognition to children.

Furthermore, a study was also done by Helen Gramman, Sarah Gott, John Little, Christine Merrell, Peter Tymms & Lee T. Copping (2018). In their study, they made a prima facie case for identifying a single pathway in the learning of Hindu-Arabic numerical symbols and discuss why this ability may be a critical gateway concept in developing mathematical competencies. Equally the same the current study is proposing a teaching/learning trajectory for teaching number recognition as follows: identification of number, naming number, matching numbers to their representative quantities and writing numbers.

Additionally, in Janner Simarmata et al, 2018 study, a representative sample of English and Scottish children was assessed using a number symbol identification paradigm in the performance indicators in primary schools (PIPS) Baseline assessment at the beginning and end of their first year while in the current study only non-school going Zambian children surrounding a university in question were assessed using observations, response to instructions and interviews and no Rasch analysis of real and simulated data was used, to show that, there appears to be a single unidimensional pathway in learning to identify number symbols with discrete difficulty stages and on examination of differential item functioning, that pathway was invariant across gender, country, socio-economic background, first language and across the first year of schooling. Furthermore, this was not a baseline study but a pilot study which was meant to be a yardstick for designing an observation checklist to assess number recognition in children and also help students on how to conduct interviews with children which is one of the ways of assessing children and yet rarely talked about in early childhood education forums in Zambia. Janner Simarmata et al (2018) also found that, almost all children make progress along the pathway during the year but the current study has not yet implemented its model to assess whether the non-going school children are going to make progress at the end. Their recommendation was that, a number identification scale may thus be a universal ruler which all pupils could be assessed. But this current study is recommending that, there are various ways in which children can be assessed on their abilities to recognise numbers such as clay moulding, folder games where children match numerals, art creations and physical activity among others.

Man preet Singh (2022) also updated own article on a guide to number recognition where own highlighted the importance of number recognition, beginning different teaching techniques and employment of usage of external help for more engaged learning. The target group in Singh's, 2022 article was Amazon Associates and not non-school going children in villages under study. And there is nothing wrong in adopting their definition and techniques on how to teach non-going school children that have difficulties in recognising numbers (Proofreading by UK, 2023) to ensure validity and reliability of a research article.

Masoud Ghassemi, Fariborz Dortaj, Ismail Saadipour and Ali Delavar (2022) studied the effectiveness of teaching counting and number recognition strategies in improving the basic number skills of children at risk of mathematics in pre-school age in Jordan. The purpose of this study was to investigate the effectiveness of counting and recognition strategies instruction on the number skill of children at risk. The research method was a quasi-experimental design with two experimental and control groups with pre-test and post-tests. The population consisted of pre-primary school children aged between 3 and 6 years old, trained in Tehran. Cluster random sampling was done from 4 regions. Experimental groups were subjected to countless counting and number recognition strategies for 4 weeks each week in 45-minutes sessions. The results were analysed by multivariate analysis of covariance. The results showed the total value of the Jordan number sense test, and the number recognition at $p<0.05$. The quartet's conclusion was that, training counting and recognition strategies has been very effective in improving the skills in a number of children with mathematics problems and will play a proactive role in future mathematics disorders.

Existing literature in Zambia on early numeracy from Grade 1 to 4 (for example, Nagisa Nakawa, Satoshi Kusaka, Masato Kosaka, Koji Watanabe & Takuya Baba, 2020) say that, one of the biggest challenges for primary school children is moving beyond the use counting in calculation. This study was on Grade 1 to Grade 4 and not on early learners aged 3-4 years who were not going to school in surrounding villages to Tipangeni University. Furthermore, a study was done by Getrude Chimfwembe Gondwe (2023) on counting skills of non-school going children surrounding Maliko University. Chimfwembe-Gondwe (2023) found that the biggest challenge among non-going school children was that some children failed to respond to the researchers instructions, others could not put the numerals in order, others when numerals were randomly picked by the researcher they got confused, while others were feeling shy to respond, some identified one and four but could not identify the rest. However, the current study differs from Chimfwembe-Getrude (2023) study in the sense that, this study focused on a different skill thus number recognition which is usually not understood and in most cases, it is overshadowed as it develops at the same time as counting (Twinkl, 2023).

Furthermore, this current study also differs from Nakawa et al, 2020's study in the sense that, the purpose of Nakawa et al, 2020 study was to investigate how Zambian Grade 1 to Grade 4 children at primary school sees a group of 10 as an effective pattern and structure with the given concrete material while the purpose of this study is to develop a model for teaching non –school going children as a supplement to Governments efforts of free education, an emphasis on financial literacy and entrepreneurship. This current study consists of three phase pilot studies and the main study will come later. Nagisa's and others study consisted of three phases consisting of two pilot studies and the main study, during which a total of 146 children from Grades 1-4 were asked during interviews to perform certain tasks. This current study consists of three pilot studies, data was collected by in-service train teachers that had started in the second year, while another in another pilot, data was collected by in-service train teachers who started training in the first year but were in the second year at the time of data collection, the last data collection was done by first year students who were just 04 months in the university. Nakawa

et al (2020) tasks focused on number competencies related to counting objects, recognising number patterns and structures of concrete objects, and composing and decomposing numbers. While the tasks in the current study focused on identifying numbers (children learning how to correctly and automatically recognise numerals between 0 and 6), naming numbers (children being able to recall the name of a number upon seeing it in either numerical form or as a quantity), matching numbers to their representative quantities (children learning how to look at a quantity of objects and matching this quantity to the correct number), writing numbers (children being able to learn how to write numbers, both as words and in their numerical forms. In Nakawa et al (2020) study, the response categories of PASA (pattern and Structure Assessment) framework in number competencies were modified to analyse the data.

In the current study, data was analysed thematically and by use of frequencies and percentages. This was done so as to identify themes thus, patterns in the data that are important or interesting, and use these themes to address the research or say something about an issue. The aim of Nakawa et al (2020) analysis was to identify the degree of the acquired pattern and structural thinking. The results of the two pilot studies showed that in formal addition with two-digit numbers, all children counted without identifying a group of 10' while some used concrete materials, some recognised numbers in a pattern and identified a group of 10'which has been previously observed in Zambia. The main survey showed that children were able to manipulate concrete objects and to recognise a group of 10 in the given 10-frames. The results confirm that children have the potential to develop the skill of transitioning from manipulating concrete objects for calculations but this is missing in the current Zambian syllabus but need to be investigated in the main study. While the findings in the current study show that, in villages surrounding Tipangeni University, most children can partially recognise some numerals. Nakawa's et al (2020) findings offer new insights about positive learning processes in the Zambian Primary school children. The current study offers insights on the entry behaviour of these non-school children into level 3 thus 5-6 years. These five researchers in Nakawa et al (2020) concluded that, the results can help to provide appropriate support in class and at curriculum level while this study concludes that, the results may help in providing a model and innovations on number recognition on how to roll out activities in disadvantaged communities.

A number of models have been proposed in Zambia (MOGE, 2018 & IPA, n. D). MOGE (2018) proposed a model where District Resource centre co-ordinators (DRCC) visited a small number of schools, one Vvob co-ordinator visited 20 schools each month, zone INSET co-ordinators visited all five schools in their zone at least once during the pilot and senior teachers visited each catch up teacher in their school a number of times. To get started, in September, 2016 training started, Oct-Nov 2016 in Chipata the pilot started for one month in 20 schools, term-time during class time, 1.5 hours of numeracy a day and one grade 3, 4 and 5 class per school, Feb-July, 2017 there was another pilot in Monze and Pemba during term-time, outside class time, one grade 3, 4 and 5 class per school. This pilot was allotted one hour a day for two terms in 40 schools. In the same year thus 2017 in April-May 2017, there was another study for one month in the holiday in Katete which involved 20 schools, 1.5 hours numeracy a day, one grade 3, 4, and 5 classes per school. In all pilots, teacher assessment results were close to the independent assessment results. This gave confidence that the improvements seen are genuine and that there is still need to check assessment process. Additionally, Innovation for Poverty Action Zambia (IPA, 2023) reports that, the number recognition end line results show that the results of teacher assessments generally match those of the independent monitors as they did at baseline. The independent data and the teacher show a similar distribution. Further analysis showed a slightly greater proportion of learners in the lower levels than the teacher data, which show more learners in levels 3 and 4. To reduce the possibility of bias, mentors can make random checks during assessment and during implementation to make sure learners are in the correct level.

MoGE (2018) model used the MoGE monitoring system. This system uses a cluster way of sampling participants such as Districts, Ngo's, Zones, and schools with office bearers already assigned while the current study used participants who were just snowballed. Furthermore, the current study was a pilot design and has not been implemented to scale while MoGE (2018) is also a pilot by MoE in 80 schools in 2016 and is being scaled to 5000 schools with the aim of reaching all grades 3, 4 and 5 (Teaching at the right level, 2023). The programme is being implemented by MoE with technical support from Unicef Zambia, VvoB –education for development and Teaching at the Right Level Africa Abdul Latif Jameel Poverty Action Lab (J-PAL) Pratham Education Foundation and is targeting children in grades 3, 4 and 5 while the current study is in its infancy looking forward to be implemented by the researcher with help from any well-wisher. Just like MoGE (2018) train teachers in the current study are motivated to learn research with children and parents urged the researcher and research assistants to be going to those villages to teach their children as they have no resources to take their children to formal schools (Chimfwembe Gondwe, 2023).

4. Methodology

This study was conducted using observational methods and interviews during the second term from January to April, 2023 for full-time students and during December/January residential, 2023 for distance students. The researcher with the help of distance and full time students went round in villages surrounding the university. The purpose of this tour was to carry on a one to one conversation, observation and assessment of the children using numeral cards on the ability to recognise numerals. An observation, verbal instruction and open ended interviews were done as children placed numerals on a number line that was drawn for them after recognition of the same numerals on separate numeral cards. The purpose of this activity was to find out if non going school children could recognise numerals on the numeral cards and place them appropriately on the number line. Because it was envisaged that, this could help children to gain confidence with numbers at an early age, build children's critical thinking skills and help children start with

a strong numerical foundation. Parents were asked and the researcher was welcomed with own research team. This was done in line with culturally relevant practices in Zambia (Juvenile Act, 1959) which stipulates that, one cannot conduct interviews or observe children without getting permission from the parents/guardian to the children. The inclusion criteria were that, the child should not be going to formal school; the data collector must have collected data on recognition of numbers. The child should be around 04 years. The parents/ guardian to the child must be present when the child is being observed and interviewed. The child should only be observed/ interviewed once by a different data collector. Data was presented thematically and using frequencies and percentages.

Results/ Findings from Pilot 01

Pilot study number 01's data collection was done by second year distance students, who were enrolled in December, 2022. This cohort did not start in the first year but it was assumed that, they had already learnt about number recognition during their diploma programme in colleges of education and will use their experience in teaching or taking care of early child hood children. What came from the field is presented in Table 01.

Table 1: Finding on Number recognition

Task	Frequency			Strategy used by the teacher	Observable Behaviour		
	Able	Not able	Partially able		With difficulty	With partial difficulty	Without difficulty
Recognise numerals	///	///////	///////	Use of the bubble gums to motivate children	Not able to recognise any number Lacked confidence	Able to recognise numbers 1, 3, 5 Able to recognise 1, 2, 3 (02 children) Recognise 1 & 2 Can only recognise 2 Able to recognise 1, 4, 2 (2 children) Able to recognise numeral 01	

03 children could recognise numerals, 07 were not able to recognise numerals and 08 children were partially able in recognition of numerals.02 were able to recognise numeral 1 but with no confidence. Numeral 1 seemed to have been recognised by most of the children. Numeral 3 was recognised by 02 children while numeral 2 had the highest recognition. While numeral 5 and 3 had less recognition**.** But within this recognition no child could write numerals and place numerals on a number line. The reason given after interviewing most parents including in-service teachers was that, they have heard of a number line for the first time.

Discussions of Pilot Study 01

Pilot one found that, most of the non-going school children were able to recognise numerals but had difficulties counting to reach a given point on the counting/number line or identify a number corresponding to a given point as suggested by Happy numbers Team (2023) and could not write numerals as wished for by OT Toolbox (2023). This finding resonates well with Dana Rongione (2017)'s sentiments. According to Diane (2017), he says that, there are many common problems in number recognition for young children. Firstly, it is the problem of children confusing six and nine. One of the most common number recognition problems is the confusion between the numbers six and nine, especially when the nine is drawn like an upside down six instead of as ball with a straight line behind it. When children see six and nine, they find it difficult to grasp the fact that six has the ball on bottom while nine has the ball on the top. Some children are still struggling with top and bottom, so it is only logical that they would have trouble distinguishing between these two numbers. Secondly, it is the problem of children confusing two and five. Some children also get the numbers two and five mixed up. Just like six and nine, the numbers two and five seem to be the same number, only one of them is flipped upside down. Two has a curved top with a straight bottom while five has a straight top with a curved bottom. This is understandably confusing to young children. Thirdly, it is the problem of confusing one and seven. A few children will struggle to tell the difference between a one and a seven if the one is written with slanted cap and not as a single straight line. Often a one written in that style will also have a line across the bottom of it, and this can be used to help the child distinguish between the two numbers. Fourthly, it is the problem of confusing 12 and 20. As strange as it may seem, many children find it difficult to differentiate the number 12 from number 20. It may be because they are both two-digit numbers containing a two or it could be because of the ''tw" sound at the beginning of each of their names. Regardless of the reason, this is a genuine struggle for some children and need to be handled with perseverance and patience. Fifthly, most schools require that their children be able to count to 100 and recognise numbers through 20. However, when some children reach the teens, they find it difficult to remember which digit comes first, if they do not master this when the teens are first to be introduced, it can lead to major problems of constantly flipping numbers around. For instance 21 becomes 12, 31 becomes 13 and 32 becomes 23. It is imperative when introducing the teens that teacher stresses that one always comes in front in the teen family. The sixth problem is that, when a teacher shows a child a flash card with a number on it, the child should be able to recognise the number and tell the teacher what it is. Some children recognise the number by its placement but can't remember the name immediately. Instead, they look at that number and count up to that number. At that point, they give the name of the number. This is not an acceptable practice for children and should not be allowed because it hinders the child from truly understanding the concept and recognition of the number. The sixth problem is many children do not understand the concept. They struggle with number recognition because they don't truly understand the concept. They may know the number but ask so what and

what that mean to them. To aid children in this area this study proposes the following innovation:

5. Innovation for this finding

Children should count to reach a given point on the number line or identify number corresponding to a given point. Given a number line, children should identify let's say where the object is, fill in the blank. And, when learning the first steps in addition and subtraction, the teacher should help the learners to relate movements of objects along the number line for example, the frog jumped 3 and wants to jump forward 2 more, where is the frog now? Thereafter, the teacher can introduce equations such as 3+2=? This could be done for subtraction.

The teacher needs to teach number recognition and the concept at the same time. Use flash cards that show both the number and that many objects. Play games in which you hold up a number flash card (number side only), and have the children hold up that many objects (for example, pencils, crayons or fingers). Use every method you can think of to help children understand the relationship between the numbers they see and the number of objects portrayed. And since main stream 3-4 year olds would not be complete without proudly displaying the number line on the wall (Diane Brauner, 2023) or often taped to the top of each child's table, this study is of the view that further study should look for best practices of teaching number recognition to children who are differently abled such as the visually impaired.

The finding on OT Toolbox (2023) resonates well with the current study. OT Toolbox (2023) says that, learning to write numbers is a big deal for youngsters and learning number formation correctly is an important handwriting skill to master in the foundation phase of school. As with most of the skills taught at school some children pick it up really quickly while others need a little bit of guidance before they can write their 1, 2, 3's. since teaching number formation with correct starting points and the correct path to follow when forming a number allows a motor memory to be effectively laid down in the brain, this study proposes the following model:

Model after this result

The teacher should follow the same pattern each time they form the number. Because this will allow the motor memory to become strengthened more quickly and the child's ability to form the number automatically develops. It will also free up their brain to focus more on content of what they are working on as opposed to using brain power to figure out how to make the number. This model can be rolled out using the following innovation:

Innovation for this model

Though there are a number of problems associated with number recognition, they can all be solved with the same solution: repetition and good planning of activities. The children need to see, hear and deal with numbers many times each day. Furthermore, number formation can be taught using correct starting points-at the top (visual cues could be used for example stickers, smiley face, star, small picture, anything that is going to remind them of the correct place to start that number). In the early stages of number formations the teacher should allow children to trace over numbers or dotted lines making up number. The teacher should let the children work on numbers 1 to 5 first and once children are feeling confident and happy about starting in the right spot they should move on to number 6 to 10.

The teacher can incorporate sensory input, repetition and rhythm/song. Do not rely solely on flash cards and worksheets. Instead, allow children to do some hands –on activities, movement and tactile inputs. The teacher can sculpt numbers out of play dough, form large numbers on the board or white board or drawing these numbers in the air with own hard, paint on an easel or draw large numbers on the driveway, air writing, form numbers in sand trays and sensory bags or even better, out of biscuits dough that own can bake so they eat their numbers. This is because motor skills and mathematics can be one and the same (Eileen Zajac, 2022). Furthermore, the teacher can encourage own children to form numbers out of a piece of yarn or cooked spaghetti. The teacher can trace a number on children's back and have him/her attempt to tell the teacher which number the teacher traced. Then allow the child to do the same on the teacher.

Additionally activities such as getting bottle tops and sticking them on the required dots, magnet and play dough, colour by number recognition, scoop and match, shark teeth counting, fishing for number, number treasure hunt, number match, bring family members home, parking cars, jump and say and many others (Zajac, 2022).

Results/ Findings From Pilot 02

Pilot study number 02's data collection was done by second year distance students, who were enrolled in April, 2021. This cohort started in the first year and it was assumed that, they had already learnt about number recognition in the first year in module one END 2101 Numeracy and development. The data collected from the field is presented in Table 02 below:

Table 2: Results from pilot 02

Task	Frequency in tally marks			Strategy used by the teacher	Observable behaviour		
	Able	Not able	Partially able				
Recognise the numerals from 1 to 5	//	//	/////////		With Difficulty Scared of talking	With partial difficulty Not recognising numeral 2 but very active Not arranging numbers in order Failing to identify 0, 4 and 5	Without difficulties Not shy hesitant
			//				

One child answered well, was not shy but was scared of talking and on what she did not know she was open to say I don't know if this is 1 or what because of the way it is written.01 child was able but was hesitant to answer at first but later complied after the mother encouraged own. Later, own gave the correct answer.01 child failed to arrange numerals from 1-5 and identify some numerals from 1-5 thus 0, 4 and 5.01 child failed to arrange numerals from 1-5 and only identified numeral 03.01 child failed both skills thus identification and arranging.01 child could not identify numeral 03.01 child could not identify numeral 3, 4 and 5.01 child managed to identify 02 numerals thus 03 and 04.01 child had problems identifying numbers on the number line but not on numeral cards and had problems identifying a 0. Instead of saying 0, own ended up saying number 10.01 child only managed to identify numeral 01 and failed to arrange numerals in order.01 child managed to arrange and write all the numerals.01 child managed only to identify one number thus 01 and put one number in order thus 0. The picture below is a sample of child trying to recognise numbers on a number line.

Sample Picture of the child trying to recognise the numerals

Discussions of findings from Pilot study 02

The conclusion from this pilot study was that, some children were able to recognise numerals while others could not. And most of the children were partially able to recognise numerals while 01 child had no problems. These types of children are what Correy and Carey, 2007 in (Silver et al, 2021) referred to as subset knowers. But the result differs from Carey (2007) who said that, not until children are three nor four years of age do they fully grasp the cardinality principle in the sense that the children in question were between 3 and 4 years. However, this result may be similar to IP etal (2018) who said that, recent work suggests that, children show an early sensitivity to counting (Alex M. Silver, Leanne Elliot, and Mellissa E. Libertus (2021).

However, the current study was not on counting but was number recognition. In fact, hands –on learning is by far the best way for children to their numbers because they can manipulate an object themselves. But parents do not just count out loudly to their children and expect them to recognise numbers. Playing with toys allows children to see, touch and help them to understand what each number means. Actually, the three researchers say that, eighteen month-old infants showed a preference for correctly ordered counting sequences; that is, although they were unable to recite the count list themselves, they recognised and preferred to listen to the correct order of the number words. Similarly, 14-to 18-month old infants appear to be able to use their ability to recognise the count list to help them overcome typical memory limits. In line with this, three to five year old children who did not fully understand a number word nevertheless still displayed some partial knowledge when asked to produce a set of that size, and this partial knowledge predicted their likelihood of fully understanding that number word a few weeks later (O'Rear et al., 2020). Actually, together these studies suggest that young children have an early recognition of number words that they may use to then refine their understanding of numbers.

Therefore, this pilot study recommended an innovation as follows:

Innovation for this finding

Children should be exposed to numbers in school. Also children should be exposed to a number line, numerals and counting. And parents should teach their children number recognition before starting school. Furthermore, a novel version of both type of tasks for arrangement and recognition should be taught and tasks such as can you give me-----number of items (for example, can you give me three stones) and tasks that bring out questions like which one has---Should be emphasised. There should be expansion on the types of comparisons used in prior versions of the task. Specifically, larger range of numbers, more varied types of number comparisons, word control practice trials to control for children's general ability to follow directions, and a procedure for both in-person and remote administration should be expanded.

Model to be used after this finding

The model to be used is an adaptation of the catch-up model already being implemented in Zambia (Vvob, 2018) or MOE model (2018). In this model there should be a comparison of performance between non-school going children to school going children, on target number that is small to large target numbers. Explore whether children at various knower-levels may perform above chance on questions where the teacher sets up two scenarios and ask children to point at let's say three. Children should be assessed both remotely and physically.

The exclusion criteria in this model should include dropping children who refuse to complete the task, refusal to complete task after starting, researcher error in interviewing and observation, incorrect responses on practice trials, and all parents providing encouragement to their children, or otherwise react to children's responses. But for trials where parents would interfere after children had already made a response, that should be coded as children's initial response and for trials were parents interfere before children response, children's response should be excluded.

Results from Pilot 03

Pilot study number 03's data collection was done by first year full time students who were still receiving instruction on developing the concept of number in early years but were under constant guidance by the author. The data collected from the field is presented in Table 3

Table 3: Result from pilot 03

TASK	Frequency			Strategy Used By The Teacher	Observable Behaviour	
	able	Partially able	Not able		Without difficulty	With difficulty
Recognise numerals from 1 to 5	04	01	06	Not pre-arranging numerals Use of bubble gum Greeting the children before observing	01 child arranged numerals according to what came next after the other	Failing to respond Shyness 01 pupil identified one & four but failed the rest

From Table 3 above, it was found that, 04 children were able to recognise numerals, 01 were partially able and 06 children were not able to recognise numerals. Among the able children, 01 child was even able to arrange numerals according to what came next. Whilst among the unable, they were children that failed to respond, some were shy, some identified one and four numerals but failed the rest and others run away in the process of an observation. Here is an example on how the observation started with one that identified one and four numeral but failed one.

Observer: *How old are you?*
Child: *4 years*
Observer: *Have you ever been to school?*
Child: *No*
Observer: *producing number cards which had numbers and ask what number is on the card*. What numbers are on the card?
Child: one, four (*child only identifies first and third, the rest fails*)

Discussions of findings from pilot study 03

Some children were able to recognise numerals; others were not able to recognise numerals, while others were partially able. This finding is similar to what David C. Geary, Mary k. hoard and Jennifer Byrat Craven (2008) in their literature review mentioned. David C. Geary et al (2008) cited that, *in the first grade, there are similarities in the number line representations of low achiever and children with mild learning disabilities, specifically in comparison to typically achieving children, they are less accurate in their placement of numbers on the line and delayed in the development of a*

linear, mathematical representation of the number line. However, their citation differs from the current one in the sense that, that review was on grade one and the study was longitudinal that sought to address the similarities and differences in the development of number line representations of children across pre-kindergarten with mild learning disabilities and low achievement. David C. Geary et al (2008) study was also done by testing hypotheses regarding potential working memory mechanisms that may contribute to group differences in the development of this system while this current study is a pilot trying to come up with observation tools to assess number recognition among non-school going children.

Related to non-recognition of numbers on the number line, (Chang Xu, Sabrina Di Lonardo Burr, Heather Douglas, Maria Ines Susperreguy Jo-Anne Levre, 2021) say that, domain –general cognitive skills such as spatial abilities and executive functions are important skills for number line performance. If children do not understand the spatial relationship between numbers for example, the distance between 2 and 3 is the same as the distance between 5 and 6; they cannot accurately place numbers on a number line.

In the current study, children also exhibited different behaviours such as hesitating to answer and shyness. This finding resonates well with raising children network (2006-2023). This network acknowledges that, some children are naturally shy. This means that, they're slow to warm up or uncomfortable in social situations.

In the current study, it was also found that, some children lacked confidence while others walked away from the interview among others. This finding in line with what Rosemary Vasquez, L. C (2000) said. According to Rosemary (2000), children provide more accurate information when they are freely narrating, rather than when they are being asked direct questions. Since, children in the last pilot study exhibited different behaviours. This study recommends that:

6. Recommendations for this Study

Spatial arrangement of number board games is needed to help children to place estimates on the number line especially, boards that should be arranged in such a way that, the relative position of the numbers are emphasised.

In future shy children should be given time to feel comfortable, parents should stay with their children in social situations, like playgroups or parents groups, while encouraging them to explore, assure the children to know that their feelings are ok and that they will help them manage the problems and many other supportive ways that encourage brave social behaviour (raising children network, 2006-2023). Furthermore, parents should encourage brave social behaviour.

Teachers and parents should encourage children to ask questions and ask them to share whatever, they would like about themselves or their family. The interviewer should also assess developmental stages and interview setting among others (Rose mary Vasquez, 2000)

7. Recommendations for Further Study

Further study should investigate demographic factors, such as country of education and family socio-economic status and how they relate to development of children's number line assessment skills (Ramani and Siegler, 2008, Xu et al., 2013). Because it is well known that, studies have indicated that in some countries like China and the United States children have differentiated ability in number recognition skills because of the countries of education.

Since, the typical approach of averaging across trials or within grades may obscure relevant variability that can be used to understand children's performance; further study should look for alternatives. An alternative approach is to use latent variable analysis, which is based on the assumption that a data set consists of a mixture of observations, in this case patterns of estimation error, from a number of mutually exclusive latent classes (for categorical variables) or profiles (for continuous variables) are critically analysed.

Further study should consider using multinomial logistic regression to determine whether social economic status, verbal counting, number identification, number comparison and executive function relate to latent class membership.

Final conclusions and recommendations on the three pilot studies

In conclusion, from the three pilots done in villages surrounding the named university, some children were able to recognise numerals; others were not able to recognise numerals, while others were partially able. Children also exhibited different behaviours such as hesitating to answer, shyness, lack of confidence, walking away from the interview among others.

Therefore, this study recommends that, since number recognition itself is made up of four main individual skills thus identification of number, naming number, matching numbers to their representative quantities and number writing and that its development depends partially on social economic status, verbal counting, number comparison, executive functions among others and that children use a combination of these skills to develop their overall number recognition skills and that each skill is vital for children's educational development, the model of strategy planning which this study endeavours to come up with should encompass the four skills involved with number recognition as follows:

Model of strategic plan

Learning progression for number recognition	
Skill	Expected Outcome
Number identification	Children should learn how to correctly and automatically recognise numerals between 0 and 9
Number naming	Children should be able to recall the name of a number upon seeing it in either numerical form or as a quantity
Number matching to representative quantities	Children should learn how to look at a quantity of objects and match this quantity to the correct number
Number writing	Children should write numbers, both as words

	and in their numerical forms. If there are children struggling with writing of their numbers the right way round, teachers/ parents should focus on improving their number formation skills more before advancing on other areas of recognition.

The above model was adapted from Douglas Fryre, Arthur J Baroody, Margaret Burchinal, Sharon M Carver, Nancy C. Jordan, Judy Mc Dowell (2013) from own book entitled Teaching Mathematics to young children

Furthermore, the strategic plan should incorporate other number recognition methods such as, encouraging engagement with numbers in the real world and through visual or tactile activities in the classroom; Learning to address visual discrimination, one-to-one correspondence, subitizing, and assessment. Also, incorporating number recognition in daily conversations-this will help children to develop an understanding that numbers hold different values; Making the conversations simple as over-complicating things can result in children getting confused; using words such as more, less, longer, shorter, higher, lower, heavier and lighter among others. And teachers/ parents should reinforce number sequencing. Because this will help their child to understand that numbers value, and that numbers are in a certain sequence. Learning number sequencing will help their child to make sense of numbers in their mind, and it also helps them to improve their counting skills. Additionally, teachers/parents should use the counting principles. Children should be taught that, each object can only be counted once, and each object is assigned its own number, and these numbers are said in a certain order, the order in which objects are counted does not matter until they are assigned a number. Furthermore, when using counting principles, it is important to teach children that when they have counted the last object that number is also the total number of objects that there are. Because this skill will enable children to answer the simple question, how many objects are there? And begin to understand that each number has a different value. Not only that, but teacher/parent should use counting activities such as counting the amount of pencils in a box, counting pebbles or rocks in your classroom garden or even counting the amount of apples there are for everyone to enjoy. And teacher/parent should use songs and rhymes. Songs can be repeated. Repeating songs will help the information to become stored in their children's long term memories. Teacher/parent should play number games such as, number scavenger hunt, creating number jewellery and baking number biscuits.

Additionally, other methods and approaches are that, parents can use non-toxic modelling clay. Each week parents can introduce a new number to the child; show the child how to form the number by moulding it from clay.

Parents can also devise file folder games to teach a child number recognition. Parents need to procure a basic manila folder. The parent then draws pictures that represent a certain amount. To play the game, the parent helps the child count a group of pictures. If there are three objects, the parent helps the child select the card with the number three written on it. The child then sticks the card beneath the appropriate picture.

Parents can involve children in physical activities-a parent can write the numbers one through ten on ten pieces of construction paper. Own laminates the papers and tapes them in random order on the floor. The parent then tells the child to hop on the number. Once the child chooses a number on which to hop, the parent tells the child the name of the number she is standing on. When the child is familiar with the numbers one through ten, the parent can call out a specific number and the child jumps on the correct card.

Parents can involve children in art work to reinforce concepts by own taking construction paper; write the number that the child needs to learn on it. The child is provided with old buttons, macaroni, or any other decorative objects. Next, the parent tells the child to glue the items on top of the outline of the number. After the artwork is dry, the child can practice tracing the number with own finger. This allows her to memorise how each number is written

Since learning number recognition prepares children for future mathematics concepts like addition and subtraction which can be learned before a child begins kindergarten (K. T Solis, 2023), further study should also, establish, addition, subtraction and number formation skills of children in these particular villages. Because while number recognition and formation are closely related, number formation focuses solely on formation of numbers whilst number recognition incorporates many more number skills as alluded to in the recommendation. And if a parent creates interactive lessons that allow children to move, create, and play, own can help her child gain a firm foundation on which other skills can be built.

Ethical Statements

Since this is a built-up to the initial studies, the study rose on earlier permission from MOE, and verbal permission from the Dean. Verbal Permission was also sought from parents of the children.

Author contribution

The author contributed to the conception and design of the study, manuscript revision, reading and approving the submitted version. Performed statistical analysis and wrote the first draft of the manuscript**.**

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflict of interest**.**

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Appendices

1) Observational schedule

Observation Schedule summary
Name of the child----------
Name of the observer---------- -------

Skill	Types of recognisers		
	Recogniser	Partial Recogniser	Non-Recogniser
Identification of number			
Naming number			
Matching numbers to their representative quantities			
Writing numbers			

2) Interview guide

Identify the number
Name the number
Match numbers to their quantities
Write the numbers

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