Investigating the acquisition of numerical ability.

> 'Mathematics is a powerful tool which has its application rooted in the use of mathematical models and symbols to represent and find solutions to problems which occur in everyday life.'
>
> (Edwards 1998)

Mathematics is also considered to be a very difficult subject to learn because some elements are very abstract. For young children, learning is about developing a sense of meaning and understanding of the world around them. Mathematical learning occurs when children interact with others, through the active exploration of 'concrete' objects and materials (sand and water) within playful situations in a variety of contexts. Young children initially learn through watching, imitating actions and handling objects and exploring space around them. It is through these interactive playful situations and social interactions that children develop a love for learning which is vital in the early years to develop confidence to explore new experiences. Young children characteristically have a natural curiosity for learning and respond with enthusiasm to stimulating, challenging and exciting interactive playful experiences. Therefore as a practitioner free play activities should be provided along with a carefully structured, activity based curriculum, within a well-resourced environment with adult involvement and play opportunities for children to learn. The purpose for this is that children learn better when they are interested and motivated to learn as they concentrate and persist on a task long enough for learning to occur.

> 'This in turn makes learning a purposeful and pleasurable experience.'
>
> (Edwards 1998)

Time for mathematical play provides children with valuable opportunities to develop and practise skills and gain mastery of mathematical ideas in 'pressure-free' situations. Children learn from others and will ask questions to clarify ideas which is

an important process of mathematics as the need to have an understanding of knowledge and skills depends on a child having understood previous ideas. Playful contexts represent part of the Foundation Stage Curriculum and work researched and analysed by Hutt (1979) identifies play behaviours in relation to children's learning and contribute to children's acquisition of numerical ability in the early years. These are *epistemic* and *ludic* behaviours. *Epistemic* behaviours are related to the acquisition of knowledge and skills through the use of language, visual experiences and exploratory practical investigations and problem-solving activities with objects and materials. Activities to stimulate *epistemic* behaviours may include: individual or collaborative free-play experimentation with unfamiliar objects, teacher directed interactive exposition of new concepts or skills in number, looking and reading books with a mathematical theme, learning a new number song or rhyme or acting out real-life mathematical experiences in role-play simulations. These examples are designed to stimulate *epistemic* behaviours in nursery/reception but are relevant throughout the primary age range. The second behaviour is *ludic* and this involves the practice or rehearsal of mathematical skills already required. This enables

> 'children to develop confidence in applying new learning and to gain mastery of learned skills.' (Edwards 1998)

Activities such as teacher directed oral counting, mental arithmetic games, free sorting and classifying activities, free play with construction toys, representational or fantasy play and revisiting books and rhymes and completing a workbook exercise to reinforce understanding all contribute to *ludic* play behaviours for children to learn mathematical concepts and skills. Providing activities and experiences with both *epistemic* and *ludic* behaviours allows children to receive a healthy balance of learning and mastery to take place in the early years. There should be a recognition

that play extends beyond childhood into the world of adults as children do not outgrow play but their modes of play change as their needs change. Changing modes of play in mathematical learning moves from play with objects to more sophisticated rule-bound play and representational expression.

Throughout mathematical development planning, assessment and reporting are important elements of teaching

> 'but they have to be manageable if the information they yield is to be useful to you, the pupils and others.' (NNS DfEE 1999)

Assessments can inform teaching plans at each level in a continuous cycle of planning, teaching and assessment, which is part of everyday classroom activity. The importance of assessment is to check children have grasped the main teaching points, whether they have any misunderstandings that need to be put right and whether they are ready to move on to the next activity. Assessment is also the review and recording of progress children are making over time in relation to key objectives and whether or not children can apply their skills in a new context or whether weaknesses still remain. Assessment helps to identify children's progress against specific targets, including those with IEPs and provide feedback and help set new targets.

> 'We have to know what children have learned, where they are finding difficulties, and by implication, what new learning opportunities should be offered, in order to structure teaching and the content of lessons.' (Edwards 1998)

Assessment enables teachers to obtain a more accurate impression of a child's performance to set tasks appropriate to the individual or group ability. To achieve this teachers have a range of assessment techniques at their disposal: observation, questioning, testing or self-assessment and they must be clear about whom and what they are assessing when deciding what strategy to use. The assessment needs to be valid and reliable in order to be effective. Within the early years assessment through

close observation is a continual and integral part of providing an appropriate curriculum for all children. The Early Learning Goals for mathematics are outlined in the Foundation Stage (2000) and the Key objectives for reception (NNS 1999) are both used to assess children's learning and development.

Hutt (1979) believes that *epistemic* and *ludic* play behaviours and activities contribute to children's numerical acquisition and learning. Activities to stimulate epistemic behaviours were a major focus during my teaching experience. Developing mathematics in reception class involved a mental starter, which included learning new number songs/rhymes and teacher directed interactive exposition of new concepts.

> 'Number rhymes and action songs help children to become familiar with the number names.' (Hopkins 1996)

Rhymes can be used to link written numbers and can be adapted to provide extra challenges. Provision activities are available for children to experience free-play problem solving, investigating numbers, shapes, materials or books. The mathematic focus during phase two has been the teaching of number.

> 'The primary number curriculum can be seen as a cycle of learning about the number system whilst using and applying that knowledge.' (Hopkins 1996)

Children in the early years count and begin to use and apply their counting with simple calculations through interactive activities such as number rhymes, number cards and lines and practical counting games. The task involved the children selecting a number card from the number line 1-20, identifying the written number and making a tower of cubes to match that number. *Recognise and use numerals 1 to 9 extending to 0 to 10, then beyond 10* (NNS 9-10 1999). Learning to count requires a range of different kinds of knowledge and skills and in order to evaluate the children's numerical ability in counting I used Schaeffer (1974) stages of counting. These are

recognising small numbers, being able to compare more or less, being able to say the number names in order, being able to say one number for each object, knowing the last number you say is the number of the whole collection and being able to compare and estimate numbers. Child A was able to *say the number names in order* to twenty and when asked to choose a number she was able to select the number nine and build a tower of cubes independently. This child is able to *recognise small numbers* without counting but just by looking otherwise known as *subitising* the recognition of number symbols. She is also able to say *one number for each object* by touching the cube and saying the next number word in sequence and has *cardinal aspects* of numbers as she was able to say the amount she had rather than counting the tower again. At the end of the activity child A was able to identify the smallest and largest number out of the children's towers this is the ability to *compare and estimate numbers* (Appendix 1). Child A has a good understanding of counting and number recognition and is ready to progress beyond twenty. Some activities to extend her development would be to match collections of a selection of objects to numbers, match numbers to dot patterns, find number pages in the books and spot numbers around the school and say what they are and to continue to record written numbers. Child A needs to be encouraged to take part in *ludic* activities involving practice and rehearsal of her skills already acquired to develop further learning and mastery skills in number.

Child B is able to *say the number names in order* to ten and then she needs support. She has no recognition of number symbols above three and simply guesses the rest. Gelman (1978) believes where a breakdown appears in the counting process between two and five the child has had limited early experiences. I asked child B to select a number and she choose ten but could not point to the number on line. She

randomly pointed at several numbers before I offered support. When I asked why she selected this number she replied, 'It is a big number and I want to build a big tower.' From this I believe this child is aware of ten being a big number (1-10) but not in relation to other numbers above ten. Child B was able to count ten cubes and build a tower independently and was able to *say one number for each object* when counting her tower of ten. This child has the ability to count in sequence with cubes using tag - counting. She has no idea of number symbols and cannot match a spoken number to a written number independently (Appendix 2).

> 'Some children are able to count a small number of objects
> but with no recognition of number symbols.' (Edwards 1998)

She cannot match the written number 3 to three objects and can only copy numbers with evidence of emergent attempts to represent other numbers. Her targets are to continue to recognise numbers 1 to 10 using number cards and fans in practical counting, sorting and matching the numbers to the objects. Interactive number games are *epistemic* experiences, which will help in the context of mathematical learning and development of knowledge and skills.

> 'Learning which is consolidated and extended through games
> and gives children opportunities to practise their mathematical
> skills and knowledge'. (QCA 2000)

Having these experiences will help to identify numbers around the classroom and this repetition will help her to copy and write numbers (to five) independently.

Child C has the ability to *say the number names in order* to twenty and beyond and is able *to recognise small numbers* to fifteen when point to the number. She chose number fifteen and independently built a tower of fifteen cubes and was able to *say one number for each object* when counting. She was also able *to compare and estimate numbers and say the number for the whole collection*. Child C works and

learns more effectively through experiencing *epistemic* behaviours and has difficulty in recording her ideas and numbers without support (Appendix 3). She needs encouragement with *ludic* behaviours to rehearse the skills acquired and help develop number writing and recording exercises to practise arithmetical skills and reinforce understanding of number, and at the same time continue to take part in *epistemic* experiences to apply new learning and to gain mastery of learned skills.

Assessment is vital to identify the level a child is at, to see what difficulties they are experiencing, to correct any misconceptions and to plan appropriate levels of work for them to complete. The information I discovered throughout my continuous assessments provided me with evidence to plan tasks to suit the needs of the children in order to develop their mathematical knowledge and skills. The process of assessment is necessary in order for children to develop in all areas of learning and will provide a true picture of children's strengths and weakness allowing room for development and progress. Assessment provides information to allow teachers to plan tasks for children at each end of the spectrum making decisions about curriculum planning and implementation. The classroom environment, organisation and management should support assessment opportunities and assessment should be an integral part of teaching and learning to receive the full benefits. Teachers must value assessment as a professional tool which enables

> 'the monitoring of children's progress and achievements to take place within the context of a fair, consistent and easily managed system.'
>
> (Edwards 1999)

Bibliography

Edwards	1999	Managing Effective Teaching of Mathematics 3-8 Chapman London
Hopkins	1996	Mathematics In The Primary School A Sense of Progression Fulton London
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Appendix

The children taking part in the task are reception children and are taken from the lowest and middle ability groups. Child B and C are the weakest of the three children in mathematics. All children work and try extremely hard with their maths and enjoy taking part in the activities available. The reason I selected the children was due to the fact I knew they needed extra support, through teacher discussion, and I wanted to find out what support and progression they needed. The activity was chosen because the focus was number and symbol recognition and it was an interactive task that kept the children interested and motivated to learn. This task also created lots of language and discussion about number.

Appendix 1 Examples of Child As number work

Appendix 2 Examples of Child Bs number work

Appendix 3 Examples of Child Cs number work

Appendix 1

Child A

Appendix 2

Child B

Appendix 3

Child C