

MATHEMATICAL ASSOCIATION



supporting mathematics in education

Primary Mathematics

IN THIS ISSUE:

- Getting started with early algebra
- Engage children with mathematics ...
- 'Let's visit Numberland'...
- Mathematical reasoning ...
- Subitising game cards
- Progression in reasoning
- Creative Digital Mathematics...

SPRING 2015 • Volume 19 • Issue No. 1

'Let's visit Numberland' – a highly emotive and efficient reason for reasoning in early numeracy

Gerhard Friedrich
and **Barbara**
Schindelhauer
explore how
Numberland gives
young children a
'reason for
reasoning'

Children learn best in their daily play, so the easiest way to get children to engage in a topic is to get them emotionally involved and to put it into a relevant, playful context. It helps to take a child's perspective, incorporating how children that age think, what they like and need, the knowledge they can build on. This ensures a solid bridge from their inborn understanding of mathematics to the formal language of maths. In terms of reasoning, we want to give children a 'reason to reason' while building their early numeracy skills. The imaginative early maths concept 'Let's visit Numberland' has been doing this since 2004, with fun and success for children from four to six years of age.



In an imaginative land the children meet the numbers through stories, songs, tangible experiences, active games and creative work – with a lot of shared communication and interaction. It is an emotional and playful, open yet structuring concept, inviting children to explore mathematical coherences with body, mind and heart. The focus is on the numbers 1 to 10 at first, but the concept later extends to the numbers to 20.

Numberland turns abstract number into an emotional, tangible happening with a lot of shared interactions and the children's own ideas. The children visit each number in its geometrically shaped garden, with its house, its tower, and things that go with that number. During each Numberland visit, the children discuss and experience a range of aspects of number through motion, active games, stories, songs, and topics related to each specific number and its connections to other numbers.

The underlying research study showed significant effects on both mathematical relevant thinking and language when children visited Numberland once a week for 10 weeks (Friedrich & Munz 2006). The concept is widely used in Germany and has been adapted in several countries, including the UK. The basic idea is as simple as it is engaging: We invite the children to visit a land where the numbers live and discover with them lots of things to do, to play, to enjoy – and to reason. The basic questions are 'Why is that?' and 'How could that be?'

Reasoning through Number Town

Number Town: In Number Town, the numbers 1 to 10 live next to each other. The numbers live in geometrically shaped gardens with a house, a tower – and various things that go with the number. Each element displays aspects of the numbers in a specific way, helping children to understand and make connections. They also provide plenty of reasoning opportunities for children. Typical questions are: 'Why is it like that?' or 'How could that be?' The children build Number Town on the floor with specific materials and with everyday items.

Number puppets: These animate the abstract numbers and appeal to the magical and emotional thinking of children. They are included in the stories and can be easily reinforced as children enjoy playing with them. Each number is characteristically designed, for instance number Two has two feathers on her hat, number Three holds three bells, number Eight has eight freckles and so on. The children can explore these characteristics but of course also design number puppets according to their own ideas. The numbers may talk to the children, helping to arrange their number garden, or be part of role play.

Houses: Each number has a house to live in. Number One's house has 1 window, Number Two's 2 windows and so on. The houses six to ten build on the concept of 1 to 5 because Number 6's house has $5 + 1$ windows, Number Seven's has $5 + 2$ windows and so on up to Number Ten's house with $5 + 5$ windows. Each house is a cube, with houses 6 to 10 needing two cubes. These could either be double stacked like a tower or side by side like a bungalow. So the children can still use the concept of 1 to 5 when they move on to higher numbers and they experience the fact that numbers and therefore quantities can be split. They also experience how this corresponds to the five fingers on their hands. The windows are arranged as on dice, displaying a set in a specific way. The windows are plugged with pegs the children collect. This raises questions such as 'How many windows do I need? How many do I have already?



How many are missing?' Putting the windows in is fun and contributes to fine motor skills. Children find the correct house number to place on the chimney at the top of the house, so the house displays the numeral and the quantity. Having the houses next to each other, the children experience how the numbers grow.

We can move from one house to the next one together, carefully comparing with the previous house. Alternatively, we can also present all 15 houses (which includes the 7 houses with 5 windows so that the numbers 5 to 10 can be built) and ask the children to build houses for the numbers 1 to 10 with these cubes. This way, the children will experiment and come up with different ideas on how to put a house for 7 together, for example, $4 + 3$. 'That's correct, 7 windows in total!' However, if we want to provide a house for each number 1 to 10, we need another strategy...

Towers: The number towers are another way to display sets. In each garden, the children build a tower with the corresponding number of blocks. The different colours on four sides allow children to build the towers in many different ways. Perhaps in a conversation with Number Five, the children can talk about what they did, what they notice. Number Five may say something like: 'You all built very nice towers for me! Let's have a look at them.' – 'The tower I built for you has 5 red blocks.' – 'I used 3 red blocks and 2 yellow blocks.' – 'They look different, but they have the same height!' Putting all the towers 1 to 10 next to each other, the children see how the numbers grow by one – the same as with the houses, but in a different way. The children experience how to split numbers and do early operations.

Gardens: Each number has a lovely green garden in which the children put the number puppet, the house and the tower. The shape of each garden links to the geometrical aspect of the number. 'This garden has four sides, so it must be Four's garden!' 'That's right, I live in a square, thank you', says Number Four. 'Can you put it in the right place?' Four's neighbours are Three in a triangular garden (three sides) and Five in a pentagonal garden. The connection of a number to its geometric shape is very useful for children since shapes are all around us. In the context of number 4, it is interesting to elaborate on other shapes with four sides.

At this stage, the gardens with their houses, towers and numbers already display the numbers in a very clear and comparable way, providing a lot to



talk about and to play with. A further activity is decorating the gardens with small items. Furnishing the gardens is always enjoyable for the children because it is never the same and brings in fun and discussion. The level of complexity is variable.

In Four's garden, everything has to deal with 4. Sets of four items are the basis: The children may pick 4 counters, buttons or bricks, 4 pens, or 4 beans and place them somehow in the garden. Thus, all in a small place, the children see that it does not matter what a set consists of (quantity) or how it is arranged (invariancy).

The more advanced approach includes everyday objects: A horse may be placed in Number Four's garden due to its 4 legs. Yet it also has 1 tail, 2 eyes, 2 nostrils – and it's only one horse... The children discuss and negotiate where to finally put the horse – this time. Everyday things are suddenly seen with different eyes and details become relevant. It is also popular to bring in items which expand the general knowledge: A beetle with its six legs for example, leading to further exploration of different types of beetles, creative work and songs on beetles, then move on to insects in general (six legs).

John Clarke, a teacher in Manchester commented, 'For example, the children had a debate around whether two leaves should be allowed in Number One's garden. This then forced the two children who had provided the leaves to give reasons as to why they each should be allowed, resulting in one of the girls drawing the rest of her peer's attention to the fact that the leaves were different shapes and came from different trees. This would therefore mean they only had ONE from each tree, which should be allowed as all trees aren't the same.'

It is up to the teacher and the children how many gardens are introduced and in which way, depending on the interest and/or level of the children. The easiest way is to have Number One's garden fully furnished and take it from there. We sit down and take a look: What do we see? Why is it like that? The number puppet may tell us about her garden or it could ask us questions. Having understood the principle, we move on to Number Two's garden. This time, the children try to find the proper house, house number and the tower blocks.

Another way of introducing Number Town would be to distribute the gardens 1 to 5 on the floor. Number One has invited the children to Numberland and now asks the children to guess where she lives and who might live in the other gardens. We could then have a look at all the houses and work out which house would be Number One's, put one window in, the house number on top and place it in her garden. Then Number One could ask for a tower in her garden. Having put everything together, we can have a conversation about how the garden now looks. Number One could also talk about being unique. Then we can invite the children to furnish the other gardens according to the same principles. The gardens 6 to 10 may now also be included. Once basic Number Town is in place with its inhabitants, the children can bring other items to further decorate the gardens. Reasoning takes place all the time – while doing teamwork, having a conversation with the number, or being challenged by other children.

In the end, with Number Town being completed, each garden displays all aspects of the numbers in a spatially confined way. The neighbouring gardens correspond in the main elements and allow comparing. Now it is time to play and explore in these gardens. We have seen many rather fidgeting children becoming completely absorbed and concentrated in this context.

Hodgey Podgey and Forget-me-not

A much beloved character in Numberland adds zest and encourages children to reason even more. Mischievous Hodgey Podgey likes to mess around in Numberland, moving objects from one garden to another, swapping mats on Number Lane and so on. Children enjoy finding and correcting the mistakes which gives a boost to their self-confidence. Forgetmenot, the fairy of the numbers can be called to help make things right again. Of course, Hodgey

Podgey makes a perfect scapegoat for our own mistakes...

Number Lane displays the numerals from 0 to 10 (later up to 20). By laying out the mats in the correct order, decorating them with corresponding sets, moving and playing numerous fun games on Number Lane, children can physically experience many number aspects and help develop their motor skills.

Specific stories address the magical thinking of the children. For example, the sick Number Four is cured by drinking a tea that has been prepared with four times four ingredients, left to brew for four minutes and sweetened with four spoons of honey. Alternatively, stories can be made up by the teacher (Friedrich, de Galgóczy, Schindelhauer 2010 & 2011).

There are special Numberland songs, with both vocal and instrumental versions. Additional children's songs relating to a number can also be integrated (e.g. '3 Blind Mice').

Each number may trigger topics relevant to general knowledge: Honeycombs are always hexagonal, all beetles have six legs, all spiders eight. The topic spider can be explored with types of spiders, making or drawing spiders and the song 'Insy Winsy Spider'. Active games encourage even the shy.

In the 'Book of Numbers' each child collects all kinds of work related to the project. It is also a tool to encourage children who are reluctant to draw or cut, enhancing their fine motor skills. It also documents their progress throughout.

In Conclusion

The core of 'Let's visit Numberland' is the provision of a playful and comprehensive mathematically rich and interactive playing environment. The focus is always on the children, noting their individual level of development, interest, needs, and ideas. The framework, with its flexible options, provides a simple focus for both children and teachers. Daily experiences can be systematically organized and related activities can be applied. This flexibility enables Numberland to be adapted and used around the world, as is already evidenced by projects in Texas (USA), Estonia, Romania, Poland, Russia, Thailand, Turkey and the Middle East. Yet the most evident reason is that maths is a universal language and children everywhere need and enjoy the same things.

References

- Gerhard Friedrich, Horst Munz (2006). Förderung schulischer Vorläuferfähigkeiten durch das didaktische Konzept 'Komm mit ins Zahlenland'. *Psychologie in Erziehung und Unterricht*, 53, 134–146. Munich and Basel: Ernst-Reinhardt-Verlag. (English translation available at http://numberland.net/english/numberland_publications.html)
- Gerhard Friedrich, Viola de Galgóczy, Barbara Schindelhauer (2010): Let's visit Numberland – playfully discover the world of numbers. Handbook, incl. CD with songs. Waldkirch, Germany: ifvl
- Gerhard Friedrich, Viola de Galgóczy, Barbara Schindelhauer (revised edition 2011): Komm mit ins Zahlenland – Eine Entdeckungsreise in die Welt der Mathematik. Handbook, incl. CD. Freiburg, Germany: Herder

Online Resources

- www.numberland.net http://numberland.net/english/numberland_publications.html
- Gerhard Friedrich, Barbara Schindelhauer (2014). Let's visit Numberland: An Emotive, Story-based Contribution to Numeracy and Literacy Development.
- In: Jörg F. Maas, Simone C. Emig, Carolin Seelmann (eds.). Prepare for Life! Raising Awareness for Early Literacy Education. Results and Implications of the International Conference of Experts 2013. Stiftung Lesen 2014 (pp. 79-85) Free download of the e-book: <http://www.readingworldwide.com/index.php?id=51665>
- NCETM National Centre for Excellence in the Teaching of Mathematics (2011). Focus on ... Numberland. Early Years Magazine, Issue 25/2011 www.ncetm.org.uk
- Numberland resources can be obtained from www.ascoeducational.co.uk

Barbara Schindelhauer, Institut für vorschulisches Lernen (ifvl), Am Rosengarten 13, 79183 Waldkirch, Germany Tel. +49-7681-4937176
barbara@numberland.net
www.numberland.net
www.ifvl.de