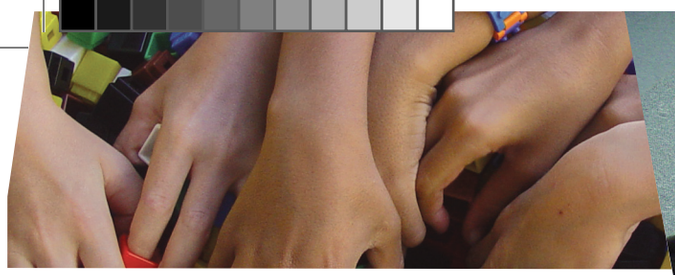
CONTENTS

Developing Mathematics with Unifix®
R.I.C. Publications®



Foreword

For many decades, the use of manipulative materials to assist young children in their learning of mathematics has been recommended. The advocacy of great educators such as Maria Montessori, Zoltan Dienes and Catherine Stern encourages a wide acceptance of the use of manipulative materials, especially in primary school classrooms. Once, it was felt that simply giving students manipulatives to use in mathematics lessons would be enough to develop an understanding of mathematical concepts. This is not true. Manipulatives in and of themselves do not teach – skilled teachers do.

This series—*Hands-on mathematics*—is designed to help teachers who are trying to make the most of students' experiences with manipulatives. We believe it is better to use a few well-chosen products rather than an array of 'bits and pieces'. We recommend 'a lot of a little' rather than 'a little of a lot' when it comes to working with manipulatives. It is better to focus on a few well-chosen manipulative materials so that students will have an adequate supply of pieces. Nothing is more frustrating than not having enough to finish 'creating a design' or 'building that masterpiece'. As well, it is important that sufficient materials are available to allow models to be left on display in the classroom.

Frequently, when we work with students and teachers in classrooms and workshops, a range of common concerns is raised. Let us share a few with you.

Why use manipulatives?

When used as part of a well thought-out lesson, manipulatives can help students 'come to grips' with difficult concepts. The key to good use of manipulatives is for teachers to have a clear goal in mind when using them. This will help maintain the intention of the lesson and focus responses to any questions asked during the lesson. Teachers will have a clear idea of what to look for when observing students using manipulatives.

As Richard Skemp, the famous educational psychologist said, 'It is as though their thinking was out there on the table'.

We have observed how students experiment with ideas willingly. If, at first, satisfaction with an idea is not achieved, students will seek another solution. We do not see this happening as frequently when students are expected to work with abstract statements such as equations and written problems.

The skilled use of manipulatives—note, we said the *skilled* use of manipulatives—will enhance mathematics outcomes. Poor use many be detrimental to student attainment. This series of books is designed to ensure skilled use of manipulatives in the classroom.

Is there a difference between a mathematics manipulative and a mathematics teaching aid?

We believe there is a big difference between the two types of materials.

A child can interact, even take control of a good mathematical manipulative; whereas a teaching aid tends to control the learning experience. Too often, a teaching aid is used as a 'telling' support rather than a learning support and experience has taught us that 'telling' is not a very successful method of teaching mathematical ideas.

How will I know whether the students are learning anything?

Observe the students as they work with the manipulatives. Don't worry if they solve a problem in a way different from what you expected. Ask questions. Encourage students to explain their thoughts or write about their experience.

In fact, actively engage with the students as their thought processes emerge. Simply using manipulatives is not enough. Students need to be given time to reflect on their activity and share their thoughts with a group or the whole class. The teacher plays a vital role in helping students connect new knowledge with old. Language plays a key role throughout this learning process.

What evidence can I show that students are learning or have learnt … ?

Some teachers are concerned about the lack of written evidence to substantiate learning when manipulatives form a large part of the lesson. There are several ways a student might record his/her findings:

- *writing about the experience*
- *sketching or drawing any models produced*
- *photographing any models produced*
- *presenting 'learning tours' to students in other classrooms*
- *maintaining a learning journey log book.*

Actually, when preparing this type of learning evidence, students have a wonderful opportunity to reinforce their own learning.

How do I manage the use of manipulatives?

Some teachers worry that students will only play with the manipulatives and not pay attention, or worse still begin to throw the material around. These are genuine fears which will decrease as experience, both by the students and teacher, increases.

As with any 'new toy' there will be a 'novelty effect'. The first time you introduce a manipulative, allow time for the students to explore it.

Set some simple rules and limits for the way the material is used and enforce these early on. Students will soon learn to respect the material. Throughout this book, management ideas are presented. We encourage you to adopt them as your own.

Snap-clap

D T E S

Purpose

For students to develop a variety of patterns and to represent these patterns in many ways.

Rhythmic patterns create a deep physical experience.

Snap

Clap

Tap

We believe strongly in the developmental notion that individuals need a physical experience to create, strengthen and consolidate concepts in the brain. For this conceptual development to occur, it is paramount that a realistic 'concrete' experience has occurred. We see 'concrete' in terms of reality, rather than solid objects. In this case, the blocks provide a platform for a 'real' developmental experience.

1 Rhythmic hand clapping, finger snapping and even knee tapping provide wonderful opportunities for creating patterns in early childhood. Students will create their personal series as the teacher (or another student) taps a rhythm.

As each individual 'acts' the pattern, the other students are invited to join in. Young students can follow the most sophisticated patterns set by their classmates.

Different 'taps' can assume different actions—even the following sequence!

snap, snap, snap, clap, snap, snap, snap, clap, snap, snap, snap, clap could mean, 'Now is the time to get your play lunch'.

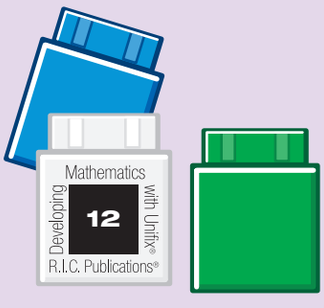
2 Create a 'train' (a long stack) of two blocks of one-colour and two blocks of another colour. The first colour represents SNAP, the second CLAP.

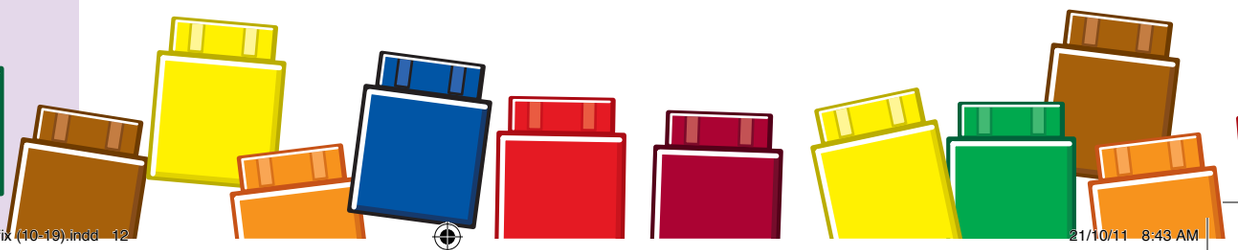
Read the 'train' as:

snap-snap, clap-clap, snap-snap, clap-clap, snap-snap, clap-clap, …

Strike up a rhythm and the students can 'snap-clap' according to the codes on the blocks. Keep the pattern going after the train ends.

Introduce new colours and, hence, new actions.





Introducing number indicators

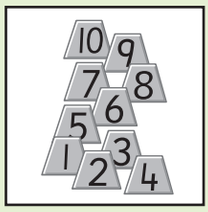
D T E S

Purpose

Students match a numeral to a quantity.

Linking numerals with groups of blocks.

Number indicators



Introducing numerals

This is the first time that numerals have been introduced—the S stage of D T E S. Prior to this, the students would have worked not only with Unifix® blocks but also a very wide range of materials, both formal and informal. Most of the work with Unifix® blocks has been at the D T stage.

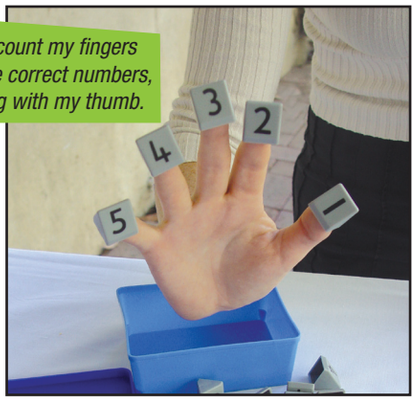
Students

- can count verbally,
- have a fair sense of one-to-one correspondence,
- appreciate the conservation of number; that is, the ability to see that six objects still amount to six, no matter how they are arranged.

In most classrooms, a number chart will be hanging on the wall and various number flashcards will be available. At this stage, we prefer to work on a number line because this seems to support the continuity concept of counting more appropriately than number grids: 'travelling along' seems more natural than 'travelling around'.

As well, students' ideas of seriation will influence counting concepts.

Tip the number indicators on the table and show your outstretched fingers.



Students place the appropriate number on the counting finger.

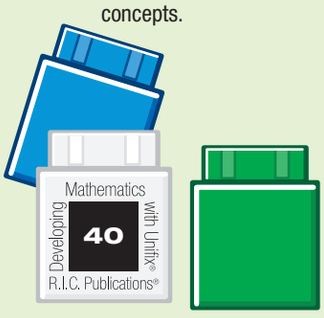
Show one block. Place the correct number indicator on top of that block.

Stack two blocks and place the appropriate number indicator on the top of the stack.

Encourage students to experiment with various arrangements of blocks and number indicators. We could make a 'story':

'I have two blocks and I found two more. Now I have four blocks altogether.'

Students will make these stories naturally.



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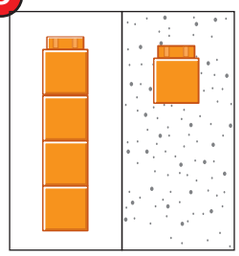

Let's go on earning more money! Add another gecko. What have we now?
Encourage a (polite!) chorus.

One lizard and one gecko.

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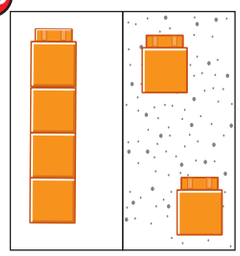

Good! Add another gecko. Now what do you have?

One lizard and two geckos.

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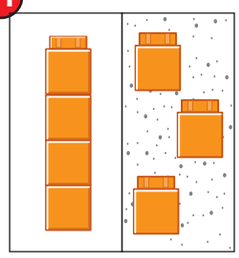

Add another gecko.

One lizard and three geckos.

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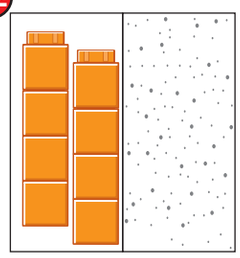

Add another gecko …

One lizard and four..or..or Hey! Hold on! We have four geckos. But, ah! um! four geckos make a lizard. You can't have four geckos in that space.

Now, look how rich you are! Quick, get your trading board looking correct. Yes! We have two lizards.

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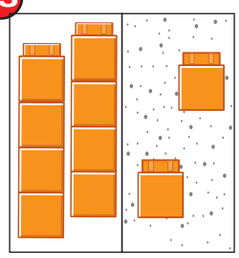

Excellent: I think you have done very well. Let's have one more go; but, this time I will clap my hands. If I clap twice, you pick up two geckos … and so on.
Play the game silently: the only sound being the clapping of your hands. Watch for those students who have gained mastery.

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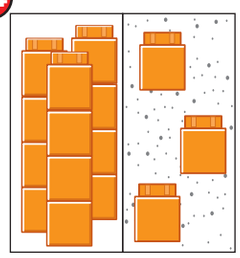

By now, we have reached 3 lizards and 3 geckos. This is an impressive collection three lizards and three geckos. What will happen if I earn another gecko?
Take all the suggestions possible and put them on show for the students to ponder. Encourage their thinking.

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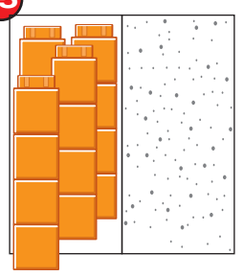


If I get another gecko I will have four lizards.

You can't have that. You can't have four in a space and, hey, there is no space for it, anyway.

Any suggestions?

Suggestions

It could go on the edge of the board.

That's a good idea. But it looks a bit messy. How can we make it look like a group of four Lizards?

You can't make a big stack 'cos that will look like a big stack and not four lizards.

Hey! What if I put a rubber band around them?

Great, but what is it called?

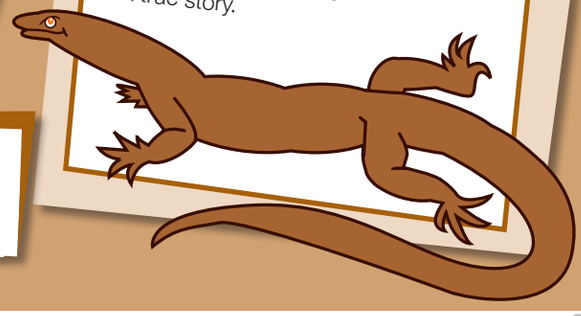
I reckon a goanna, because it is bigger.

Oh! Wow! That's getting big. What would be the next one? Ummm … four goannas.

What about a crocodile?

Oooh! A four-goanna-crocodile: that's big.

This is a typical student-centred conversation around this stage of introducing the ideas. On one memorable occasion, this game of sizes continued: 'python, iguana, alligator, boa constrictor, dinosaur. Hey, but, what sort of dinosaur?' So, they listed all until the students were satisfied that long-neck was the biggest of all. 'Hey, but, we'd never have enough geckos to make a long-neck? That's huge!'
A true story.



The name game

D T E S

Purpose

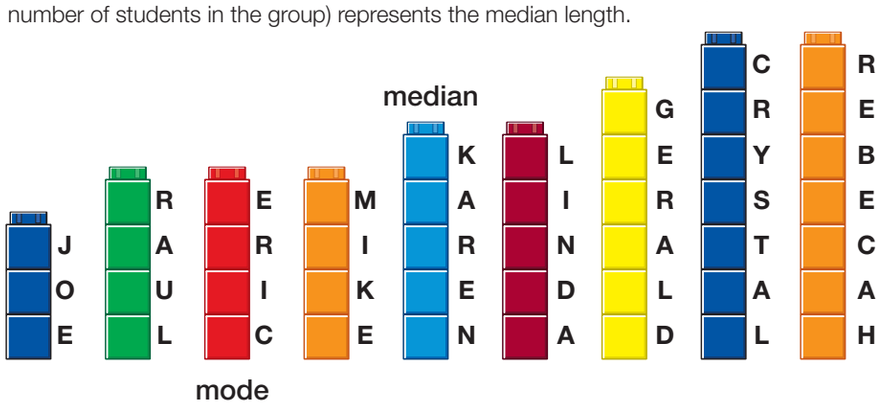
To develop an understanding of 'average'.

A practical approach to 'averages'.

1. Arrange the students into groups of seven or nine (an odd number will make it simpler for later activities). Place a pile of Unifix® blocks in the middle of the groups and ask the students to pick up and stack the same number of blocks (all the same colour) as the letters in their first name. For example, Adrian would pick up six green Unifix® blocks and join them.

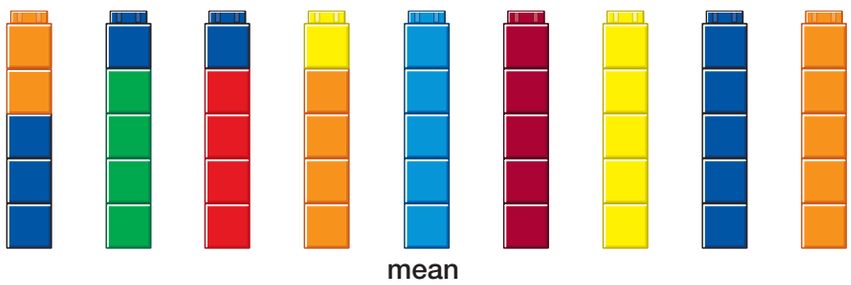
2. Ask the students to place the stack of blocks representing the number of letters in their first name in front of them. Discuss who has the longest/shortest name and which names are the same length.

3. Next, order the stacks from shortest to tallest. The stack in the middle (if there is an odd number of students in the group) represents the median length.



4. The mode refers to the most commonly occurring name length. For the group shown above, the most common name length is four letters.

5. Discuss the third type of average—the mean. Ask the students to suggest a way to make all the stacks the same height. By removing some blocks from the tall stacks and adding them to the shorter stacks you should end up with all the stacks being the same height. (At this stage don't worry if you have a block or two left over.) The final stack height represents the mean letter length for names in the group.



Background

The term 'average' may apply to several different measures. These are mode, median and mean.

- Mode is the most commonly occurring number in a set of numbers.

  Sometimes you can have more than one mode.

- Median is the middle number when a set of numbers is arranged in order from smallest to largest or vice-versa.

- Mean is the value when all the numbers in a set are added and the total is divided by how many numbers were in the set.

Note: If there were eight children in the group, stacks four and five would be added together and halved to calculate the median.