Accelerating Learning in Mathematics

Learning to: use basic facts to solve problems

Target group:
students in years 5–8

Focusing on:

- understanding connections between sets of basic facts
- fast, fluent recall of the basic fact sets necessary for stage 6
- using basic fact knowledge when solving word problems.

Beliefs underpinning effective teaching of mathematics:

- Every student's identity, language, and culture is respected and valued.
- Every student has the right to access effective mathematics education.
- Every student can become a successful learner of mathematics.

Ten principles of effective teaching of mathematics:

1. An ethic of care
2. Arranging for learning
3. Building on students' thinking
4. Worthwhile mathematical tasks
5. Making connections
6. Assessment for learning
7. Mathematical communication
8. Mathematical language
9. Tools and representations
10. Teacher knowledge

See *Effective Pedagogy in Mathematics* by G. Anthony and M. Walshaw, Educational Practices Series 19, International Bureau of Education, available at: www.ibe.unesco.org

TEACHER OBSERVATION OVER A RANGE OF ACTIVITIES

The student may have mastered the 2 times, 5 times, and 10 times tables and may know the basic facts for making 10, for doubles and halves to 100, and for near doubles to 20. The student may attempt to solve other multiplication problems by using repeated addition. They may use advanced counting or place value strategies to solve addition problems that could be solved using basic facts.

POSSIBLE BARRIERS TO THE STUDENT'S PROGRESS

1	Limited understanding of how to learn basic facts
2	Difficulty relating a times table fact to a model
3	Difficulty using facts to solve word problems

EXPECTATIONS FOR NUMBER

AFTER 1 YEAR AT SCHOOL	AFTER 2 YEARS AT SCHOOL	AFTER 3 YEARS AT SCHOOL	BY THE END OF YEAR 4	BY THE END OF YEAR 5	BY THE END OF YEAR 6	BY THE END OF YEAR 7	BY THE END OF YEAR 8
COUNTING FROM ONE	ADVANCED COUNTING	EARLY PART–WHOLE THINKING	EARLY ADDITIVE	EARLY ADVANCED ADDITIVE	ADVANCED ADDITIVE – EARLY MULTIPLICATIVE	EARLY ADVANCED MULTIPLICATIVE	ADVANCED MULTIPLICATIVE – EARLY PROPORTIONAL
NZC EARLY LEVEL 1 / NUMERACY STAGE 2 OR 3	NZC LEVEL 1 / NUMERACY STAGE 4	NZC EARLY LEVEL 2 / NUMERACY EARLY STAGE 5	NZC LEVEL 2 / NUMERACY STAGE 5	NZC EARLY LEVEL 3 / NUMERACY EARLY STAGE 6	NZC LEVEL 3 / NUMERACY STAGE 6	NZC EARLY LEVEL 4 / NUMERACY EARLY STAGE 7	NZC LEVEL 4 / NUMERACY STAGE 7

Aligned to *The New Zealand Curriculum* and *Mathematics Standards for years 1–8*

BARRIER BEING ADDRESSED **1** **LIMITED UNDERSTANDING OF HOW TO LEARN BASIC FACTS**

DIAGNOSTIC QUESTIONS

1. Tennis balls come in cans of four balls. How many tennis balls will I have if I buy:

   a. 2 cans? b. 5 cans? c. 10 cans? d. 8 cans?

2. Ask the student the questions below, telling them to say the number that comes into their head:

   a. 2 x 6
   b. 5 x 8
   c. 10 x 3
   d. 8 x 4
   e. 7 x 7
   f. 9 x 2
   g. 6 x 2

WHAT TO NOTICE IN THE STUDENT'S RESPONSE

Does the student use their knowledge of basic facts to solve the tennis ball problems?

Do they use basic fact knowledge for some of the tennis ball questions but use another strategy for others?

Can a student who knows their two times table solve 6 x 2 as easily as 2 x 6?

Note: If the student has not mastered the two, five, and ten times tables, use the ALiM resource to develop the basic facts required for stage 5.

DELIBERATE ACTS OF TEACHING

The best way for a student to learn new information is to link it to something that they already know.

Start by showing the student the 10 x 10 times tables grid and make sure that they are familiar with the concept of commutativity. Highlight on the grid the times table facts that the student has already mastered and use these to show them related times table facts. For example, if the student knows that 2 x 8 = 16, point out that they also know 8 x 2.

Seeing Double

Review the 2 times table as "doubles". For example, 2 x 6 is the same as double 6.

Introduce the 4 times table as doubles of the 2 times table. Use materials to demonstrate that two groups of seven and four groups of seven are halves or doubles of each other.

Create four number line strips (A–D), marking 10 equally spaced points on each one.

Ask the student to write out the 1 times table on line A, using the numbers 1–10, and to write out the 2 times table on line B, using the numbers 2–20.

Position line B under line A and discuss why the numbers on line B are the double of the corresponding numbers on line A.

Ask the student to write out the 4 times table on line C, using the numbers 4–40, and to write out the 8 times table on line D, using the numbers 8–80.

Position line C under line B and show the student that the numbers on line C can be found by doubling each number on line B.

Give the student flashcards with the 4 times table on them and provide time for practice.

Position line D under line C and show that the numbers on line D can be found by doubling each number on line C. Emphasise that if the student knows their 4 times table, they can use it to find the 8 times table. Give the student flashcards with the 8 times table on them and provide time for practice.

Extend the activity by working on the 3 times table. Use number strips to demonstrate that numbers on the 6 times table are doubles of the corresponding numbers on the 3 times table.

MATERIALS/LINKS

Long strips of paper

Materials for contextual problems to demonstrate doubling sets

Digital Learning Object: Multiplication and Division Basic Facts

Blank Grids
(Number and Algebra, level 3, www.nzmaths.co.nz)

Four in a Row Multiplication
(Material master 6-6a)

WHAT TO DO NEXT IF THE STUDENT IS STUCK

Keep the pace slow. Continue to emphasise links to the student's prior knowledge. Use arrays in place of number lines.

INITIATING HOME-BASED ACTIVITIES

Give the student doubling tasks by giving them a list of objects and their prices and asking them to find the cost of two, four, and eight of each item.

NEXT TEACHING STEPS BACK IN THE CLASSROOM

Use problem-solving activities that require doubling. Target independent learning based on the multiplication set that the student is working on.

BARRIER BEING ADDRESSED **2** DIFFICULTY RELATING A TIMES TABLE FACT TO A MODEL

DIAGNOSTIC QUESTIONS

Check fast and fluent recall of early multiplication facts such as two times, five times, and ten times tables.

1. If Moira knows that 3 x 8 is 24, how can she work out 6 x 8? (If necessary, prompt the student to focus on using the known fact 3 x 8 = 24)
   Answer: 6 x 8 is double 3 x 8 because there are twice as many groups of 8.
2. If 3 x 8 = 24, why is 3 x 80 = 240?
   Answer: The answer is 10 times bigger because 80 is 10 times bigger than 8.

WHAT TO NOTICE IN THE STUDENT'S RESPONSE

1. Does the student attempt to use skip-counting to work out 6 x 8 or state that they don't know their six times table?
2. Can the student suggest a reason beyond "you just need to add a zero"?

DELIBERATE ACTS OF TEACHING

Arrays give students a visual representation that can be used to explore multiplication concepts.

Double Your Facts
Use arrays to create models.

Take a known fact, such as 4 x 5 = 20, and model it using the array. Double it by modelling 8 x 5. Ask the student to model and draw several examples of doubling.

Use doubling to extend beyond the 10 x 10 times table grid. For example, double 9 x 8 to find 18 x 8.

Power Up Your Facts
Use large dotty arrays and felt pens to explore what happens to a product when one factor is multiplied by ten, for example, 3 x 4 = 12, 3 x 40 = 120. Point out that the new product is exactly ten times larger. Encourage the student to discuss the magnitude of the change, rather than simply commenting that zeroes have been added. Make links to place value.

Explore what happens when a factor is 100 or 1000 times larger, or when both factors are multiplied by a multiple of 10, for example, increasing 3 x 4 to 30 x 40.

MATERIALS/LINKS

Arrays made from clip art or stickers

Digital Learning Object: Pobble Arrays (Number, level 3)

Large Dotty Array
(Material master 6-9)

WHAT TO DO NEXT IF THE STUDENT IS STUCK

Move back to making models of a basic fact and increasing it one group at a time, using a different colour for each group added:

3 x 3 = 9
4 x 3 = 12
5 x 3 = 15 …

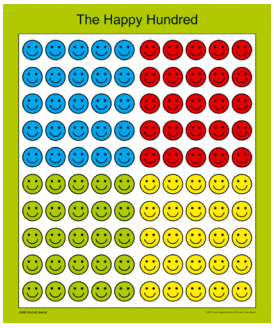
Point out that 6 x 3 is twice the size of 3 x 3.

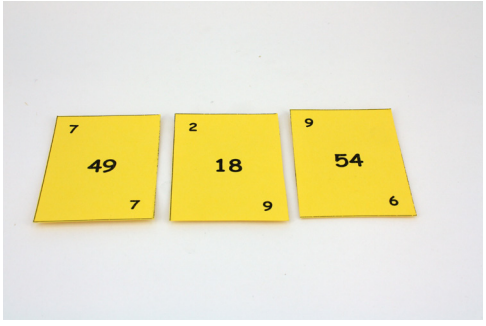
INITIATING HOME-BASED ACTIVITIES

Explain to parents that the student is learning to flexibly use their times tables to solve problems. Parents can support the student by asking times table questions and then doubling them, for example, 6 x 5 followed by 12 x 5. Parents can help the student to practise "powering up", for example, 4 x 6 followed by 40 x 6 and 3 x 7 followed by 3 x 70.

NEXT TEACHING STEPS BACK IN THE CLASSROOM

Give the student problem-solving exercises involving multiplication facts, for example, a measurement problem requiring the use of multiplication to find area.





BARRIER BEING ADDRESSED **3** DIFFICULTY USING BASIC FACTS TO SOLVE WORD PROBLEMS

DIAGNOSTIC QUESTIONS

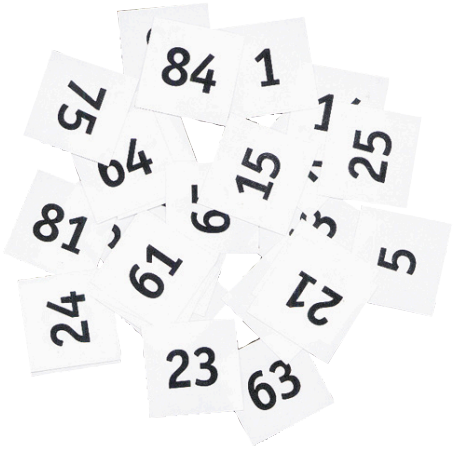
1. Write the two problems that follow on a card for the student to refer to while solving each one. Ask the student to think aloud as they work them out, explaining how they are using the numbers to reach a solution.
   a. Marley and his brother mow lawns to make money. They are given $14 at one house and $18 at another. If they share this money evenly, how much money will each brother get?
   Answer: $16
   b. The brothers rake up leaves for their neighbour. The neighbour pays them $3 per bag. The brothers rake up four bags one day and six bags the next. If they share the money evenly, how much money will each brother get?
   Answer: $15
2. Any of the problems listed below could have been used to solve the word problems. Ask the student to use their basic fact knowledge to solve:
   a. 4 + 8
   b. half of 14
   c. 18 ÷ 2
   d. 7 + 9
   e. 6 + 4
   f. 3 x 4
   g. 6 x 3
   h. 12 + 18
   i. half of 30

WHAT TO NOTICE IN THE STUDENT'S RESPONSE

Does the student recognise opportunities to use their knowledge of basic facts?

Does the student use strategies such as counting on or repeated addition?

Can the student recall the basic facts when they are presented without a context?



DELIBERATE ACTS OF TEACHING

Students may have a good grasp of basic facts but not recognise opportunities to use them when solving word problems.

Find Those Facts!
Create problems using basic facts that the student has already mastered or select appropriately levelled problems from Figure It Out or from the problem-solving page on www.nzmaths.co.nz

Work alongside the student, helping them to identify which equations are needed to solve each problem. Tell the student to highlight any equations that they can solve using basic facts. Create a list of the basic facts that the problems involve and have the student practise them for several days.

Revise the same problems a few days later, asking the student to strategise aloud. Encourage them to solve each problem without writing anything down.

MATERIALS/LINKS

Figure It Out student books levels 2–3, 3, and 3–4. See Figure It Out on www.nzmaths.co.nz for teachers' support materials.

Problem Solving
(levels 1–6 on www.nzmaths.co.nz)

Digital Learning Object: The Multiplier

WHAT TO DO NEXT IF THE STUDENT IS STUCK

Make sure that the problems are not very complicated. Give the student a single fact to work on and then create a problem using the fact.

INITIATING HOME-BASED ACTIVITIES

Give the student problems to take home and some basic facts that can be used to solve them. Ask the student to decide which basic facts can be used in each problem.

NEXT TEACHING STEPS BACK IN THE CLASSROOM

Encourage the student to actively look for opportunities to use their basic fact knowledge when solving problems.

Extend the student by showing them how basic facts can be used to solve harder problems. For example, problems involving 13 times a number can be solved using the 3 times and 10 times tables.