

Differentiating Learning in Mathematics

All these suggestions come from presentations, available online. The link to each presentation is available below the idea.

Many come from Carol Tomlinson – an ‘expert’ on differentiated learning.

Mathematics examples have been used throughout. Contextual information has been added in blue.

Symmetry Pre-Assessment



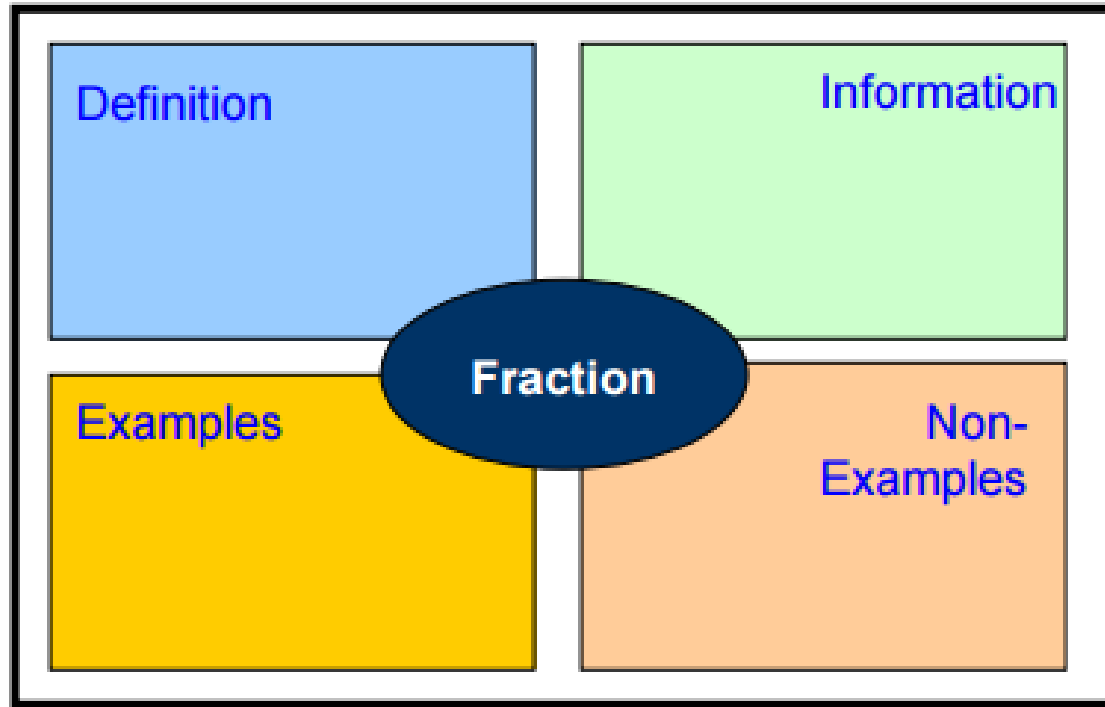
- Teacher models symmetry/asymmetry once with whole-class using two shapes.
- Teacher conducts individual assessments with a bag of shapes.
- Students tell teacher “yes” or “no” to “Does this have symmetry?” and explain why.



Pre-assessment, allowing the teachers to check understanding before teaching a topic. This can ensure differentiated groups are not ‘static’.

Directions: Complete the chart to show what you know about fractions.

Write as much as you can.



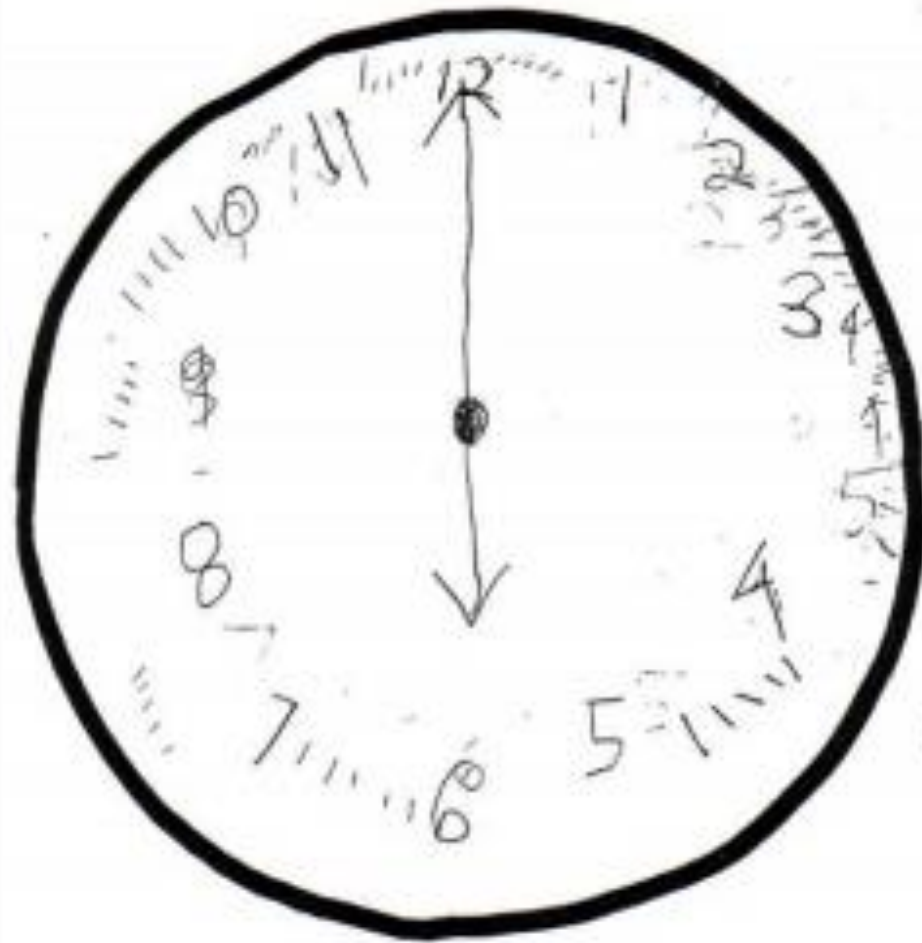
Pre-assessment, allowing the teachers to check understanding before teaching a topic. This can ensure differentiated groups are not 'static'.

This can ensure differentiated groups are not 'static'.

a clock helps you
tell time Clocks are
fun to mix it
over I can read
from the Mikeerwada
I work at 6:00
and my mom was
late for work



Pre-assessment on time – often an area of mathematics in which children will have very different experiences! Children were asked to note what they knew about time and clocks, and to show 6 o'clock if they could.



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Interest-Based Differentiation Results in Math Achievement Gains

Original Problem

One method for estimating the cost of new home construction is based on the proposed square footage of the home. Locally, the average cost per square foot is estimated to be \$46.50.

Sports

You are working at the ticket office for a college football team. Each ticket to the first home football game costs \$46.50.

Music

You are helping to organize a concert where some local R&B artists will be performing. Each ticket to the concert costs \$46.50.

Art

You have been working for the school yearbook, taking pictures and designing pages, and now it's time for the school to sell the yearbooks for \$46.50 each.

Games

You work for a Best Buy store that is selling the newest Rock Band game for \$46.50.

SOURCE: Candace A. Walkington, Southern Methodist University



Some research showed that students achieved better when problems were based on areas of interest to them. This could be as simple as including names of class members!

Another study (below) showed that using students' interests appeared to increase engagement.

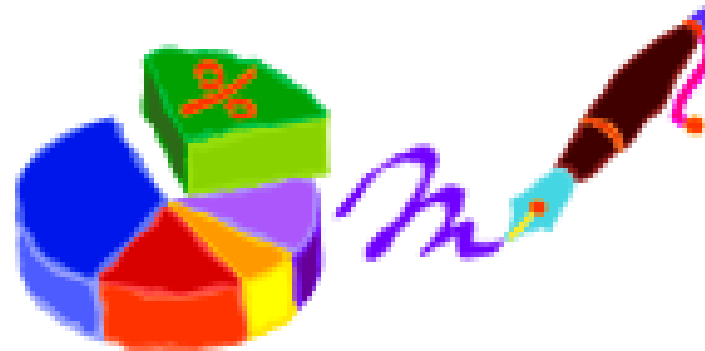
Students authoring personalized "algebra stories": Problem-posing in the context of out-of-school interests – available in library Walkington, Candace ; Bernacki, Matthew

Journal of Mathematical Behavior, December 2015, Vol.40, pp.171-191 [Peer Reviewed Journal].

Using a Strength to Support a Weakness One Example

100% Me poems

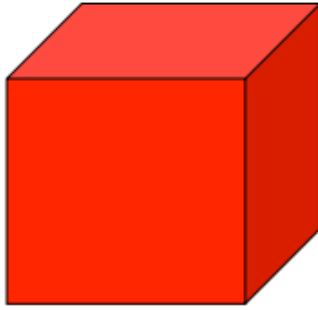
I'm 9% math
10% soccer
4% science
2% clean locker
I'm 21% wilderness
6% blue
I'm 6% braces
And 2% shoe
I'm 33% smiles 3% brown hair
4% pineapple
I'm very rare!



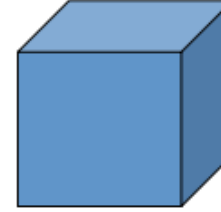
Kelsey—Grade 6

In Practical Poetry: A Non-Standard Approach to Meeting Content-Area Standards
By Sara Holbrook (2005), Portsmouth, NH: Heinemann, p. 79

Use a strength to support a weakness! Here, a pupil has used percentages within a poem.



How Cubing Works



- Students can work alone, in pairs, or in small groups with the appropriate cube.
- In pairs or small groups, each student takes a turn rolling the cube and doing the activity that comes up. Students have the choice to roll again once if they don't like the activity that turns up.
- Students each roll the cube 2 – 4 times, depending on the magnitude of the assignments.
- When working in groups, an option is to have the student who rolls lead the discussion and/or activity rolled. Have another student serve as the scribe to take notes on the group discussion. After the group reaches consensus that the task is complete, the roller and scribe change.

A cube, with different mathematics problems/tasks on each face could be made.

The teacher can write one problem on the board for everyone to use (undifferentiated),
give a different problem to each small group,
or write different problems on the backside of each card, differentiated for each group.

Can be used as sense-making after the introduction of a new concept/problem type, as a review, or as part of a homework check.

Two examples of use:

High school teacher with polynomials and systems of equations

1st grade teacher with addition and subtraction



Solve this problem. What was easy about it? Not so easy? ●	Create and solve a problem similar to this problem. ● ●	What's one question someone should ask themselves when they first look at this problem? ● ●
What's a mistake that someone might make in trying to solve this problem? Why might they make that mistake? ● ●	What mathematical concepts or terms/vocabulary does this problem show? Be specific! ● ● ● ●	Write a step-by-step set of directions that tells someone who was absent today how to solve this problem. ● ● ● ●

H. Alang, A. Mironchuk, & J. Paul (Farragut Career Academy, Chicago IL)

Another way of using 'cubing' – this time with a normal dice.

<http://www.caroltomlinson.com/Presentations/Tomlinson%20ASL%20Institute%206-13%20V2.pdf>

Understanding Number

Analytic Task

Make a number chart that shows all ways you can think of to show 5.

Practical Task

Find as many things as you can at school and at home that have something to do with 5. Share what you find with us so we can see and understand what you did.

Creative Task

Write and/or recite a riddle poem about 5 that helps us understand the number in many, unusual, and interesting ways.

Provide a choice of task based on student preferences for learning. The mathematical content is the same but the tasks differ.

Adding Fractions

Green Group

Use Cuisinaire rods or fraction circles to model simple fraction addition problems. Begin with common denominators and work up to denominators with common factors such as 3 and 6.

Explain the pitfalls and hurrahs of adding fractions by making a picture book.

Red Group

Use Venn diagrams to model LCMs. Explain how this process can be used to find common denominators. Use the method on more challenging addition problems.

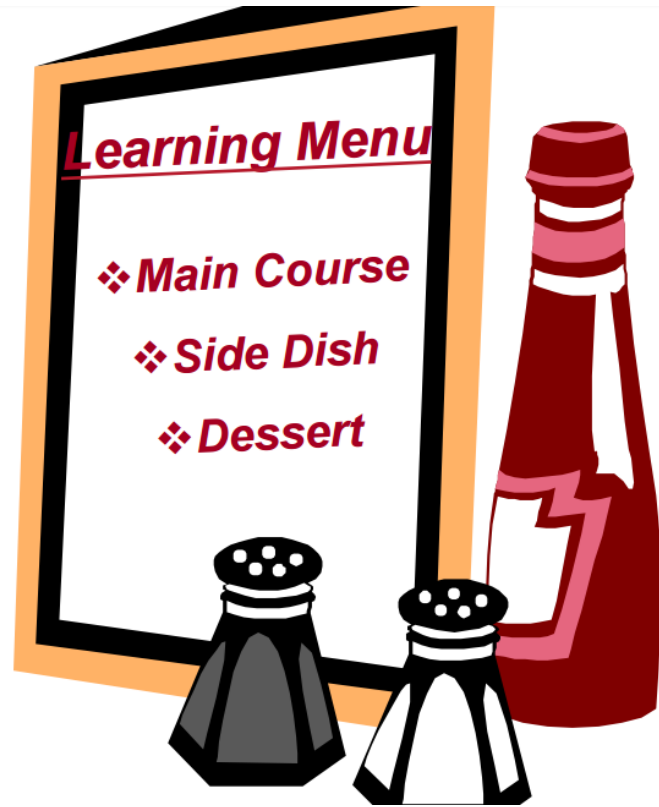
Write a manual on how to add fractions. It must include why a common denominator is needed, and at least three different ways to find it.

Blue Group

Manipulatives such as Cuisinaire rods and fraction circles will be available as a resource for the group. Students use factor trees and lists of multiples to find common denominators. Using this approach, pairs and triplets of fractions are rewritten using common denominators. End by adding several different problem of increasing challenge and length.

Suzie says that adding fractions is like a game: you just need to know the rules. Write game instructions explaining the rules of adding fractions.

Again, choice for tasks can be used – the content is similar but what the children do is slightly different.



Use this template to help you plan a menu for your classroom

Menu: _____

Due: All items in the main dish and the specified number of side dishes must be completed by the due date. You may select among the side dishes and you may decide to do some of the dessert items as well.

.....
Main Dish (complete all)

♦
♦
♦

.....
Side Dish (select ____)

♦
♦

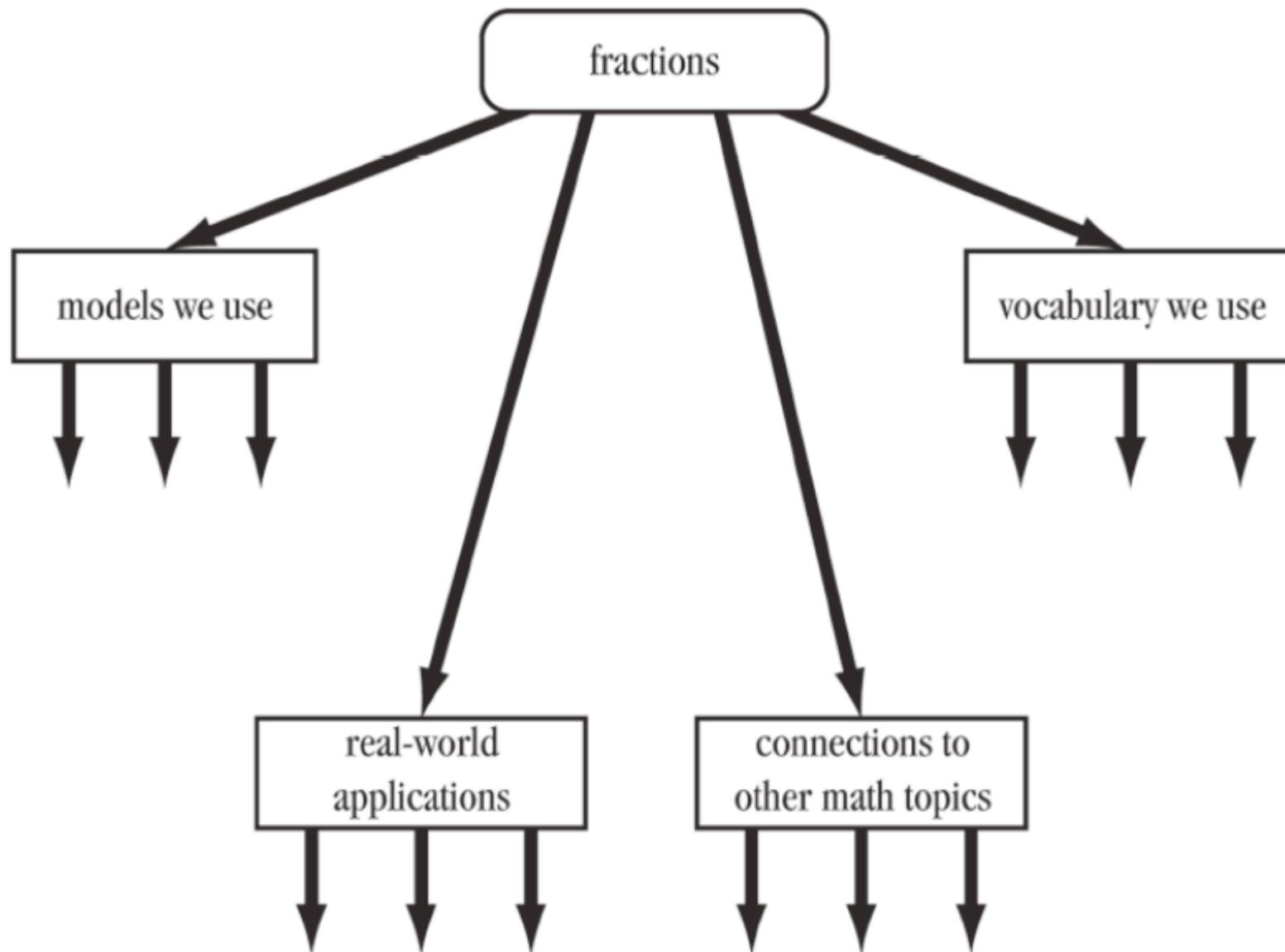
.....
Dessert

♦
♦

http://www.caroltomlinson.com/2010SpringASCD/Rex_SAstrategies.pdf

A learning menu approach means
that certain tasks are essential but
other tasks may be optional.

http://www.caroltomlinson.com/2010SpringASCD/Rex_SAstrategies.pdf



Graphic organisers can support learners.

How are a square and cube.....

Same	Different

Providing word banks
and key vocabulary
supports learners

Word Bank		
Angle	face	three-dimensional
Cube	degrees	rectangular prism
Edge	side	two-dimensional
Square	vertices	vertex

There are 14 vehicles.
There are 34 wheels.
How many bicycles are there?
How many tricycles are there?

Facts:	Drawings:
Computation:	Answer:

Graphic organiser to support problem solving. It doesn't do the mathematics but it could help scaffold the approach.

There were 48 children on the playground.
26 more came to join them.
 How many children were on the playground then?

A) 48, 26

B) 138, 134

48 2 50 8 58 26 8 68 6 74

I started with 48 and added 2 then
 got 50 then I added 8 and I got 58
 I added 2 and got 60 then I add
 8 and I got 68 then I added 6 and

There were _____ children on the playground.
 _____ more came to join them.
 How many children were on the playground then?

A) 48, 26

~~B) 138, 134~~

138 20 158 100 258 10 268 4 272

I added 138 to 20 and I got 158
 then I added 100 and I got 258, also
 I added it to 10 and I got 268
 Also I added it to 4 and got
 the number I wanted it is 272.

Let the learners choose their level
 of difficulty. Same base question –
 different level of difficulty

Number Story:

Sabina and Mike ran each day this week.
Each day Sabina ran 3 miles in 30 minutes. Mike ran 6 miles in 72 minutes.

Here, by giving a number of answers, the children have to think about what the questions could be!

Here are the answers: 42, 2, 294, 3 1/2

What could be the questions?

Open-Ended Probes

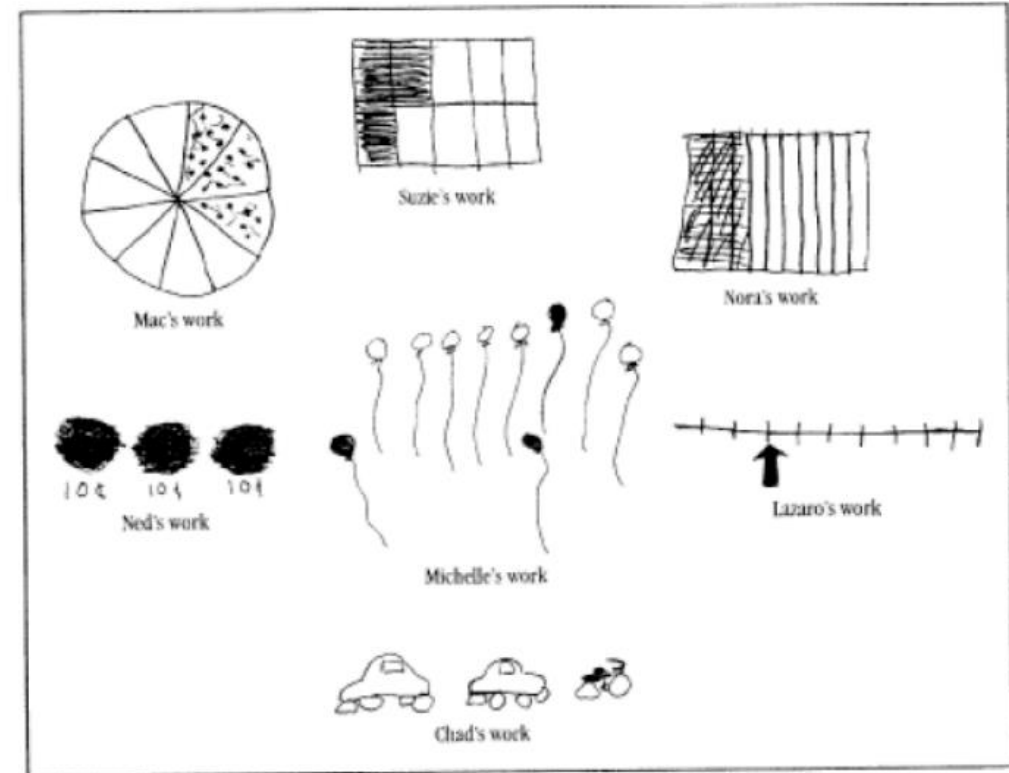
- How do you describe a cube to someone who has never seen one?
- The answer is 87. What could the question be?
- How is measurement used in your home?
- How might we write numbers if we didn't have zeroes?

Open questions
allow more
learners to
respond.

Imagine you are trying to help someone understand what three-tenths means.

What pictures could you draw to be helpful?

You can draw more than one picture. Let's see how many different pictures we can make.



Again, encouraging open responses can include more learners.