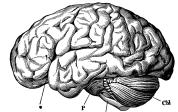


How to Teach All the Things
(including Shiny and the Tidyverse)



Formative Feedback

1

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What is $37 + 15$?



a) 52



c) 412



b) 42



d) 43

2

Welcome back. Let's start this afternoon with some very simple arithmetic. What is $37 + 15$? The four possibilities are 52, 42, 412, and 43.

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What is $37 + 15$?



a) 52

Good.

3

If you said 52, you're right.

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What is $37 + 15$?

4



b) 42

Didn't carry.

What is $37 + 15$?

5



c) 412

Column by column.

What is $37 + 15$?

6

Carried into wrong column.



d) 43

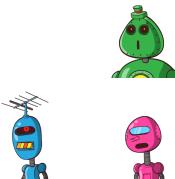
But what if you said 42? That almost certainly means that you simply didn't carry.

If you said 412, you've made progress – you're not throwing the '1' away from the first column – but you're treating the problem as two separate single-digit additions. That's a different mistake, and it would require a different explanation to correct it.

And what about 43? It turns out that some children actually do this – they carry the 1 back into the same column, because they know they're supposed to add it again, but don't know really understand where or why. Again, this is a different misconception and requires a different corrective explanation.

What is $37 + 15$? 7

Each learner **has** a different misconception

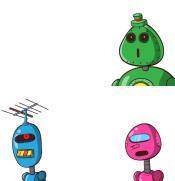


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The three wrong answers in our Multiple Choice Question (MCQ) weren't chosen at random. Each reveals that the student has a different misconception...

What is $37 + 15$? 8

Each learner **needs** a different explanation



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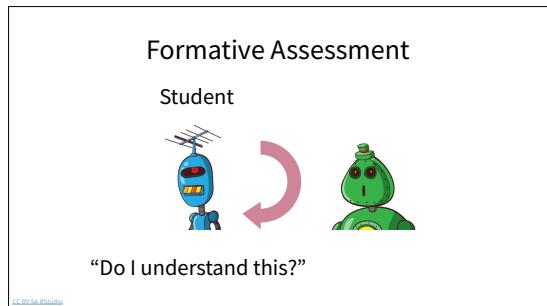
...so each one is best served by a different explanation. If we had put "99" or "a fish" as a possible wrong answer, we wouldn't actually know any more than we did about what to say next.

Formative Assessment 9

Forms (shapes) learning as it is taking place

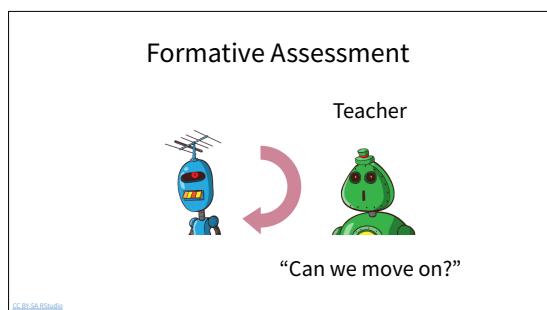
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This MCQ is an example of **formative assessment**: it forms or shapes learning **as it is taking place**.



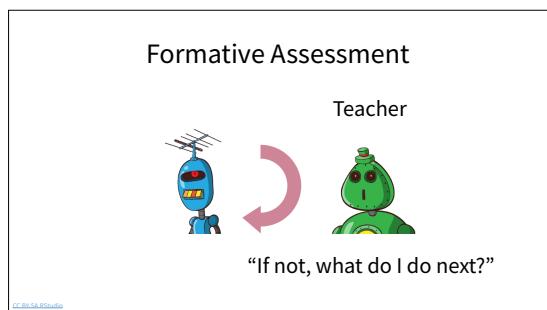
10

Checking in every 10 minutes or so during a lesson helps the student figure out if they actually understand something, or if they just **think** they understand it.



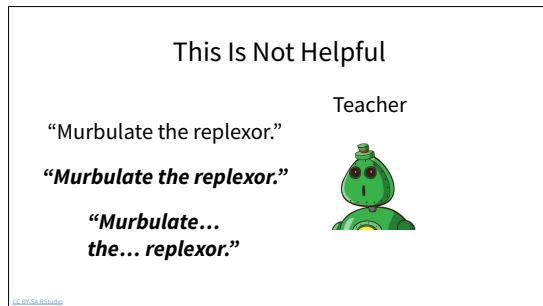
11

It also tells the teacher whether they can move on or not – after all, there's not much point introducing the next topic if most of the audience hasn't understood this one.



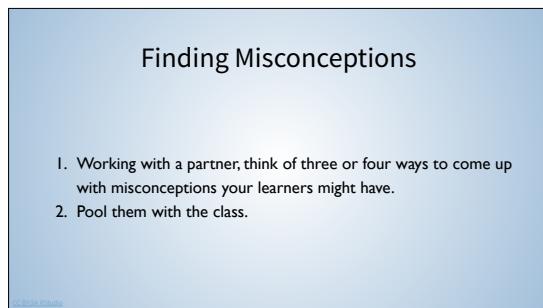
12

A good formative assessment (like this MCQ) also tells the teacher what to do next. If most people have the same misunderstanding (i.e., got the same wrong answer), explain that. If everyone's answers were scattered, the odds are good that the students are all guessing, so the teacher needs to back up and explain the topic again.



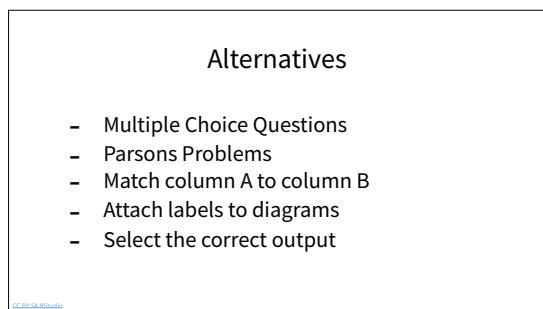
13

When you have to re-explain something, it's important to explain it a different way, or use a different example. Some people won't have understood the first time because they weren't paying attention, but others won't have understood because the new concepts didn't click with the mental model they have built so far. (This is why video courses are often frustrating: you can listen to exactly the same explanation whenever you want and as often as you want...)



14

1. Working with a partner, think of three or four ways to come up with misconceptions your learners might have.
2. Pool them with the class.



15

Multiple choice questions are only one kind of formative assessment: you can also use Parsons Problems, matching items from one column to another (e.g., words to definitions), attaching labels to diagrams, predicting the output of a short piece of code, etc. What they all have in common is:

- They're quick (so they don't derail the flow of the class)
- They have a right answer
- Carefully-chosen wrong answers allow you to diagnose misconceptions

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Multiple Choice Questions

1. Write a short multiple choice question with one right answer and 2-3 wrong answers.
2. Write down what misconception each of the wrong answers is meant to diagnose.
3. Trade MCQs with a partner: do you agree with their diagnoses?

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Taking formative assessment to its logical conclusion gives us **peer instruction**, which is the most effective scalable teaching technique we know.

- The teacher introduces the topic and presents a multiple choice question.
- Learners vote for their preferred answer.
- They then try to persuade each other, and vote again.

This approximates one-to-one instruction, and is effective because explaining your reasoning is a good way to figure out why it's wrong.

1. Write a short multiple choice question with one right answer and 2-3 wrong answers.
2. Write down what misconception each of the wrong answers is meant to diagnose.
3. Trade MCQs with a partner: do you agree with their diagnoses?