

Metacognition and Assessment

Once an accurate¹ scaffold has been created, progressive and iterative validation occurs through real-time metric evaluation (see Section on "Metric Evaluators").

Assessment, then, is a progressive assessment down the benchmark scaffold² to determine relative comprehension of learning objectives. This iterative assessment can be defined using the following operational example:

Metacognition and Assessment

Solve the following problem: $\frac{1}{2} + \frac{1}{3} =$ ▶ because $7.7 < 5.2 + 6.8$

Part* 1: *(from 5.2 token assessment)*

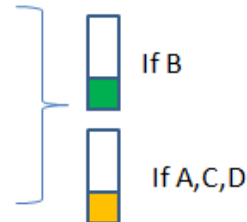
- this is a problem involving integers → see 5.2
- this is a problem using fractions → CORRECT
- this is a problem using whole numbers → see 5.2

Part 2: *(from 6.8 token assessment)*

- $1/2 = 3/6$ and $1/3 = 2/6$ → CORRECT
- $1/2 = 1/2$ and $1/3 = 3/2$ → see 6.2
- $1/2 = 2/4$ and $1/3 = 2/6$ → see 6.2

Part 3: *(from current indicator)*

- A-O $1/2 + 3/2 = 3/2 = 1-1/2$. this cannot be further factored.
- B-O $3/6 + 2/6 = 5/6$. this cannot be further factored
- C-O $2/4 + 3/6 = 5/10 = 1/2$.
- D-O cannot be solved.



•NOTES

- Steps are based on the number of precedence items (level-1) ordered by ascending order.
- Steps can be either successive or cumulatively presented to the student

Analysis of the baseline assessment then occurs as follows:

¹ aligned and validated.

² hierarchal benchmark tree

Pedagogic Analysis

7.7: Solve the following problem: $\frac{1}{2} + \frac{1}{3} =$

- Part 1:** (from 5.2)
- this is a problem involving integers see 5.2
 - this is a problem using fractions CORRECT
 - this is a problem using whole numbers see 5.2
- Part 2:** (from 6.8)
- $1/2 = 3/6$ and $1/3 = 2/6$ CORRECT
 - $1/2 = 1/2$ and $1/3 = 3/2$ see 6.8
 - $1/2 = 2/4$ and $1/3 = 2/6$ see 6.8
- Part 3:** (from current indicator)
- $1/2 + 3/2 = 3/2 = 1-1/2$. this cannot be further factored.
 - $3/6 + 2/6 = 5/6$. this cannot be further factored
 - $2/4 + 3/6 = 5/10 = 1/2$.
 - cannot be solved.

► because $7.7 \subset 5.2 + 6.8$

Metacognitive Comprehension (7.7 – N=9 students)

► **Have got it**

- DOE, Jane
- SMITH, Sam

► **Missed it**

- REILLEY, Key

► **missing 6.8**

- AUSTIN, Pete
- JANE, Sally
- O'SMITH, Sam

► **missing 5.2**

- JENKINS, Pete
- DESKLOSKI, Sam
- DONNELLY, Alton

Metacognitive Assessment Example

7.7: $1/2 + 1/3 = ?$

Question 7.1 is metacognitive analyzed following the hierarchal precedence learning order.

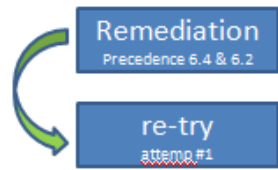
- because $7.7 \subset 5.2 + 6.8$
- Part1:** both $1/2$ and $1/3$ are :
- WHOLE NUMBER
 - FRACTION
 - REAL NUMBER
 - ? – I don't know
- Part3:** **We are:**
- ADDING 2 FRACTIONS
 - SUBTRACTING 2 FRACTIONS
 - MULTIPLYING 2 FRACTIONS
 - ? – I don't know
- Part4:** **The FIRST thing we do to solve this problem is:**
- FIND THE COMMON DENOMINATOR
 - JUST ADD THEM UP
 - USE A GRAPHIC AID TO DRAW OUT THE ANSWER
 - ? – I don't know
- Part5:** **The COMMON DENOMINATOR is found by:**
- ADDING the 2 denominators ($2 + 3 = 5$). The Common Denominator is 5
 - select the LARGEST of the denominators: The common Denominator is 3
 - multiply the 2 denominators ($2 \times 3 = 6$). The common Denominator is 6
 - ? – I don't know
- Part6:** **We factor the fractions using the common denominator as follows:**
- $1/2 = 3/6$ and $1/3 = 2/6$
 - $1/2 = 1/6$ and $1/3 = 1/6$
 - $1/2 = 6/2$ and $1/3 = 6/3$
 - ? – I don't know
- Part7:** **The answer is:**
- $3/6 + 2/6 = 5/6$
 - $1/6 + 1/6 = 2/6$ which is reduced to $1/3$
 - $6/2 + 6/3 = 12/10$ which is reduced to $6/5$
 - ? – I don't know

Metacognitive Assessment Model Analysis

Example of single assessment logic

7.7: $1/2 + 1/3 = ?$

Question 7.1 is metacognitive analyzed following the hierarchal precedence learning order.



- Part1: both $1/2$ and $1/3$ are :
 - WHOLE NUMBER
 - FRACTION
 - REAL NUMBER
 - ? - I don't know
- Part3 We are:
 - ADDING 2 FRACTIONS
 - SUBTRACTING 2 FRACTIONS
 - MULTIPLYING 2 FRACTIONS
 - ? - I don't know
- Part4: The **FIRST** thing we do to solve this problem is:
 - FIND THE COMMON DENOMINATOR
 - JUST ADD THEM UP
 - USE A GRAPHIC AID TO DRAW OUT THE ANSWER
 - ? - I don't know
- Part5: The **COMMON DENOMINATOR** is found by:
 - ADDING the 2 denominators ($2 + 3 = 5$). The Common Denominator is 5
 - select the **LARGEST** of the denominators: The common Denominator is 3
 - multiply the 2 denominators ($2 \times 3 = 6$). The common Denominator is 6
 - ? - I don't know
- Part6: We factor the fractions using the common denominator as follows:
 - $1/2 = 3/6$ and $1/3 = 2/6$
 - $1/2 = 1/6$ and $1/3 = 1/6$
 - $1/2 = 6/2$ and $1/3 = 6/3$
 - ? - I don't know
- Part7: The answer is:
 - $3/6 + 2/6 = 5/6$
 - $1/6 + 1/6 = 2/6$ which is reduced to $1/3$
 - $6/2 + 6/3 = 12/10$ which is reduced to $6/5$
 - ? - I don't know

Scoring this Assessment:
 $7.7^{122} \equiv 6.8|5.201\blacktriangle$
 Student 122 on indicator 7.1 failed at 6.4|6.2, was remediated and retried after 1 attempt to correctly answer the problem

correct answer
 incorrect answer

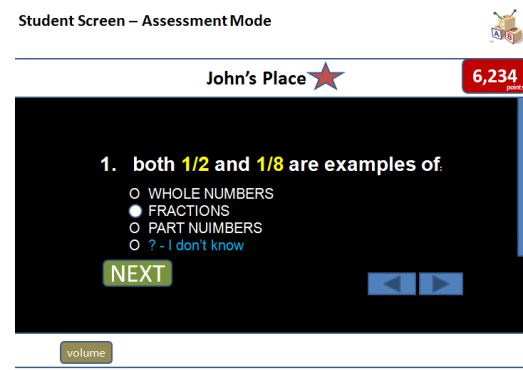
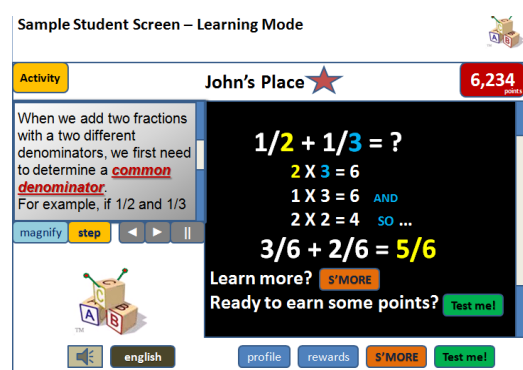


Figure 1: examples of student assessment screens (P2L implementation)