Seeable Thinking
看得到的思考

PLK Lam Man Chan English Primary School

保良局林文燦英文小學

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1. 數學科校本發展前概況

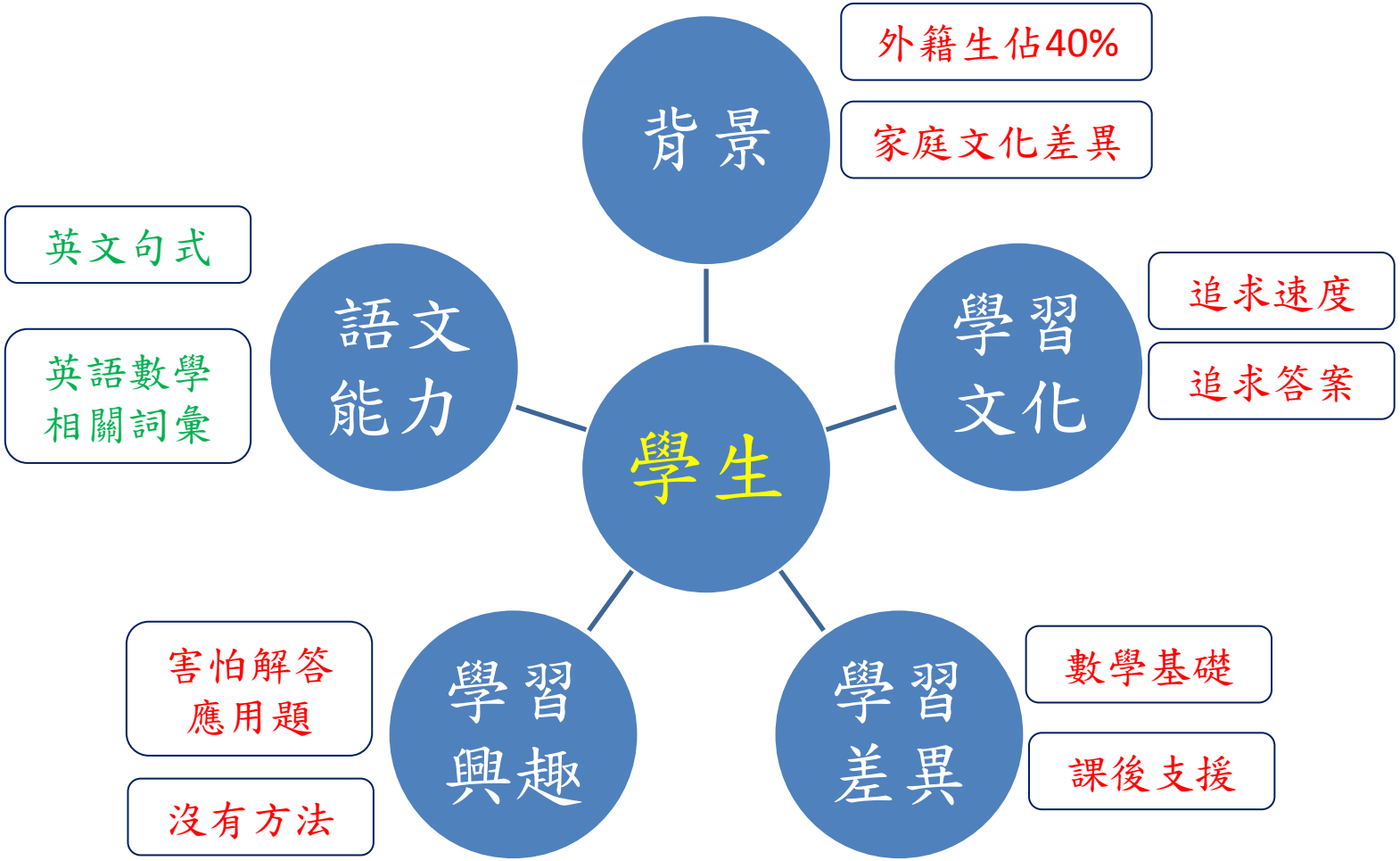
1.1 學生背景資料

- 學生來自20多個國籍的家庭
- 非本地學生人數約佔40%
- 數學課以英語為授課語言，課本、校本設計學習工作紙及課堂語言全以英語為本
- 對絕大部分的學生來說，英語並非他們的母語 – 即大部分學生以第二語言學習數學和思考。然而，學生的英語能力頗佳，均能以英語進行學習。
- 學校每班班額約為33人，現階段仍未實施小班教學

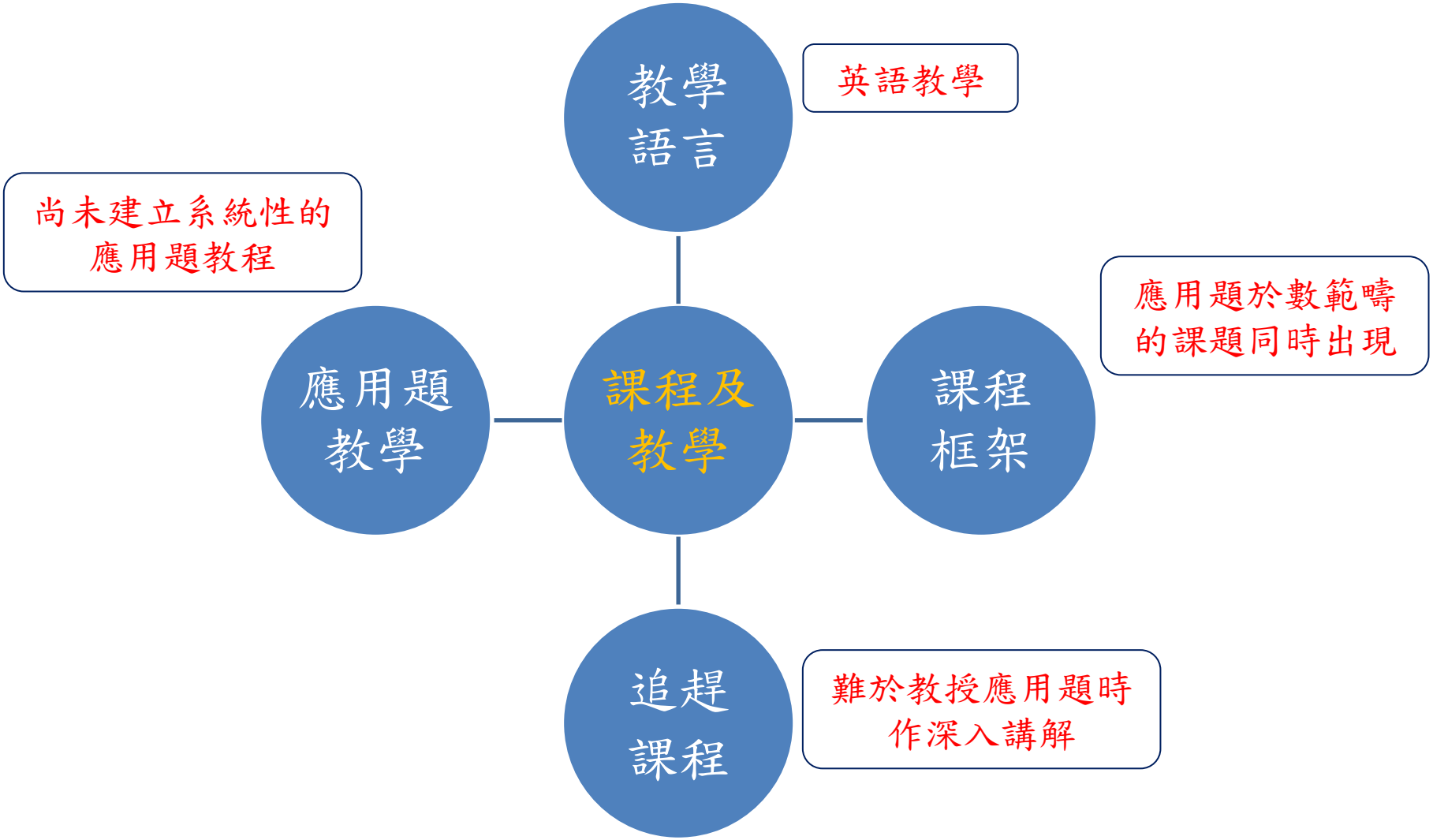
1.2 學生處理應用題的具體表現

1. 只著重關鍵字來解題：看到 “altogether”, “more” 就用加法, “ left ”, “ less/fewer ”就用減法
2. 急於列寫橫式，並計算答案，而忽略題意
3. 忽略單位，只順序計算數字
4. 學生對英語數學詞彙認識不多，找不出/不明白關鍵詞，無法解題
5. 不明白句子結構，只順序計算數字
6. 解題不嚴謹，看到不夠減，便把減法轉為加法

1.3 教授過程中的困難


學生
背景
外籍生佔40%
家庭文化差異
語文能力
英文句式
英語數學相關詞彙
學習文化
追求速度
追求答案
學習興趣
害怕解答應用題
沒有方法
學習差異
數學基礎
課後支援

1.3 教授過程中的困難


教學語言
英語教學
尚未建立系統性的應用題教程
應用題教學
課程及教學
課程框架
應用題於數範疇的課題同時出現
追趕課程
難於教授應用題時作深入講解

1.4 試行的加強措施

- 著學生留意題目字眼，圈出題目的關鍵字
- 增加練習應用題
- 提問學生題目的意思
- 著學生於課堂上口述對題目的理解

➢但效果並不顯著

目錄

2. 數學科校本發展

因應校本情況，啟動校本課程發展

- 2013-14年度，以P.2作為切入年級，教授初階審題技巧和3種圖像工具展示數量關係
- 2014-15年度，開展P.3課程調適，深化3種圖像工具的運用，以及把審題和分析步驟化，加強思考教學

2.1 校本教程目標

重視圖像表述，培養數學思維

- 鼓勵學生閱讀文字，耐心解讀情境
- 提升學生以圖像表述數量之間的關係
- 增加學生以口頭解述的機會
- 培養學生的分析能力和創意能力
- 提升運用數學語言的能力及數學概念

2.2 P.2教程內容

應用題教程重點內容: 三種圖像思考工具

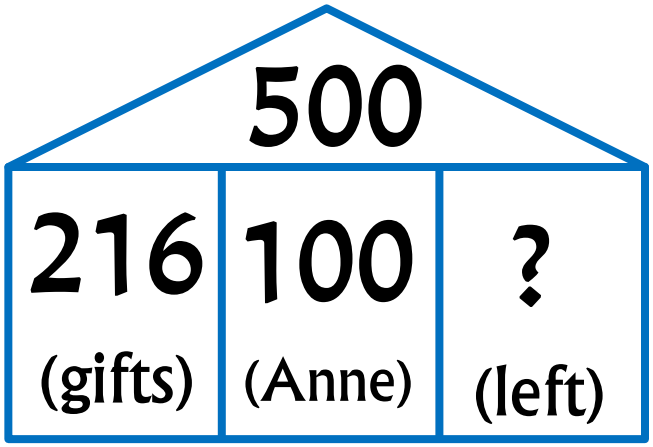
1. 組合屋(House diagram) – 求總數? 求部分?
2. 工序盒(Box diagram) – 數量的輸出、輸入
3. 線段圖(Bar diagram) – 展示數量比較或關係

註：P.2主要教學內容，P.3上學期加強教學

2.2 具體教學內容、學習材料及學生作業樣本

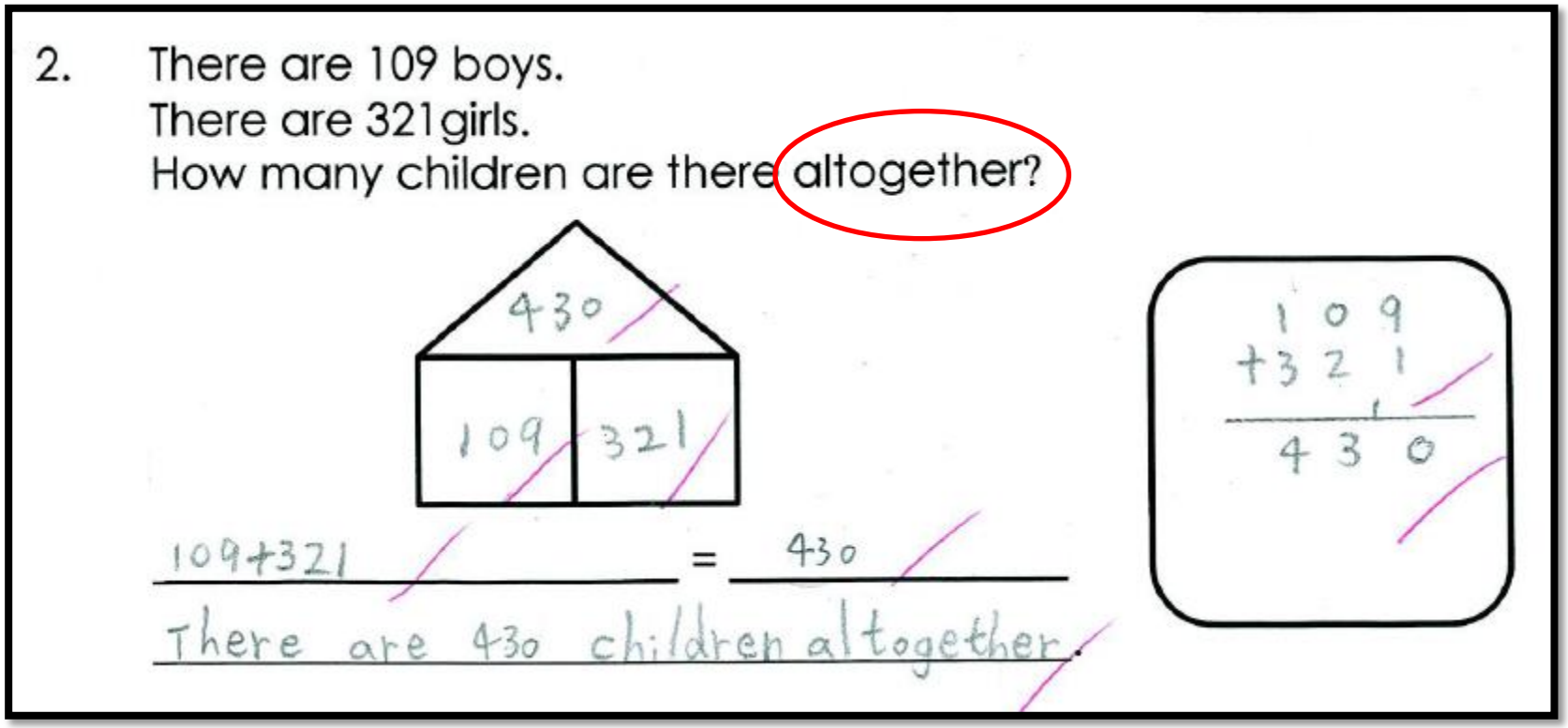
E.g. Mary had 500 dollars in her wallet.
After spending 216 dollars for buying gifts and giving 100 dollars to Anne, how much does she have now?

House diagram:



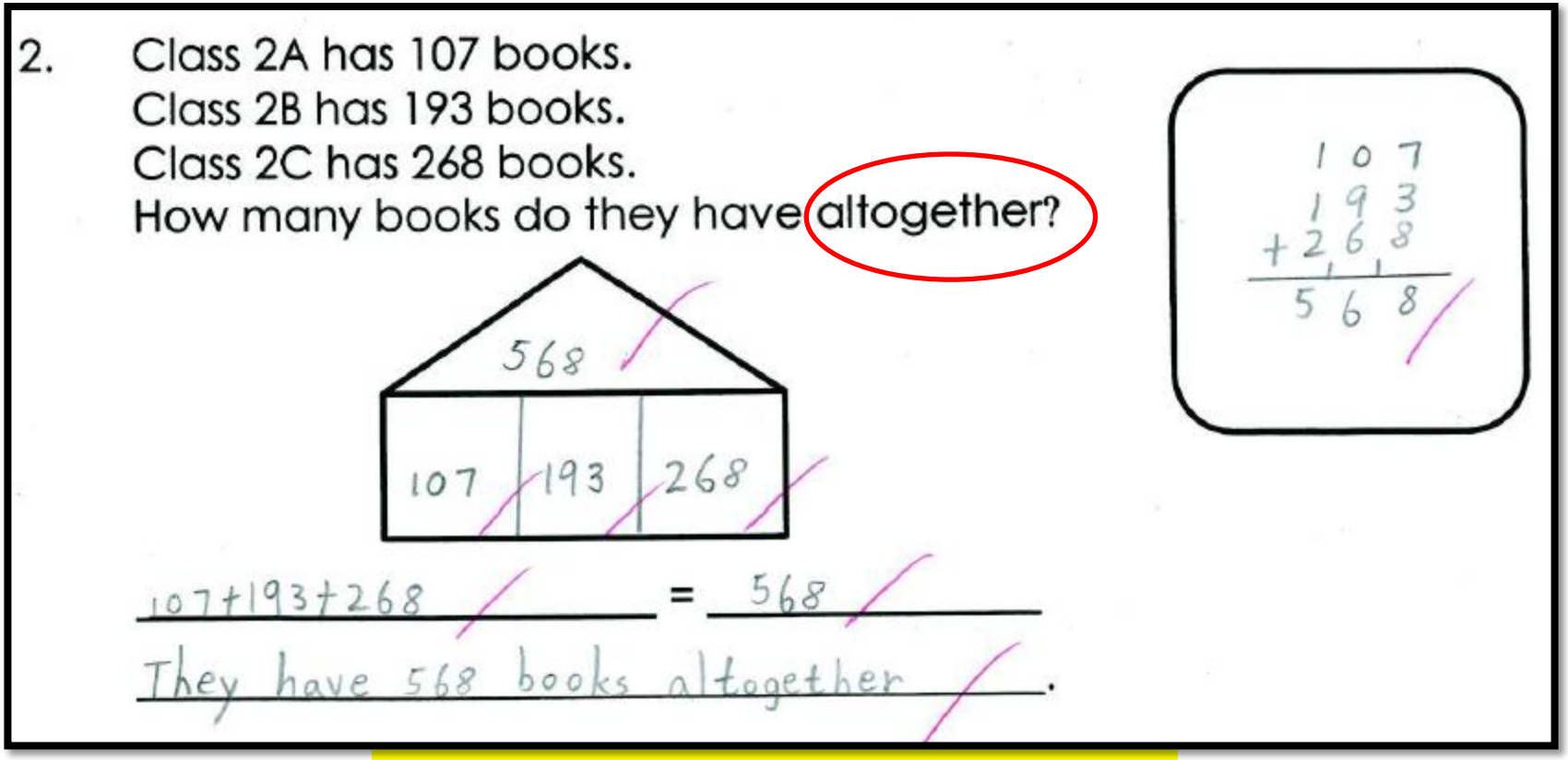
$$500 - 216 - 100$$

House Diagram – Students' work



'Sum'
(with two numbers)

House Diagram – Students' work



2. Class 2A has 107 books.
Class 2B has 193 books.
Class 2C has 268 books.
How many books do they have altogether?

568

107 | 193 | 268

107+193+268 = 568

They have 568 books altogether.

```
  1 0 7
  1 9 3
+ 2 6 8
  ,   ,
  5 6 8
```

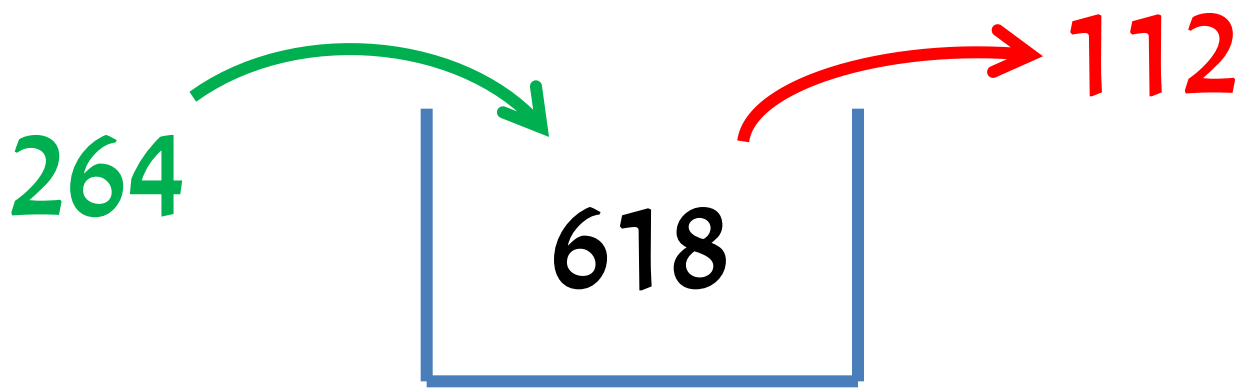
'Sum'
(with three numbers)

2.2.1 House Diagram (組合屋)

1. Given all ‘parts’, to find ‘whole’
2. Given ‘whole’, to look for the missing ‘part(s)’

E.g. **There are 618 people on the train at first.**
If 112 people get off the train,
264 people get on the train.
How many people are there on the train now?

box diagram:

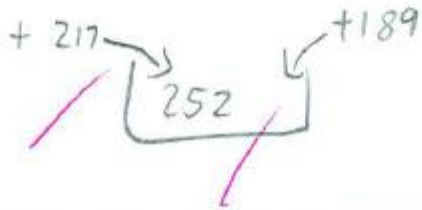


618 − 112 + 264

Box diagram – Students' work

4. Linda has 252 dollars.
If Mum gives her 189 dollars
and Dad gives her 217 dollars,
how much does Linda have now ?

Box diagram



Horizontal form 252 + 189 + 217

Box diagram – Students' work

Draw the box diagram and write the horizontal form for each question.

1. My sister had 750 dollars.
   She spent 238 dollars on books yesterday
   and she spent the same amount of money on a fan today.
   How much money does she have now ?

Box diagram

Horizontal form 750 - 238 - 238

Box diagram – Students' work

There are 982 cans of soft drinks. If 303 cans are sold (-out) in the morning and 482 cans are sold (-out) in the afternoon, how many cans of soft drinks are left?

982 − 303 − 482
= 679 − 482
= 197

197 cans of soft drinks are left.

Column form

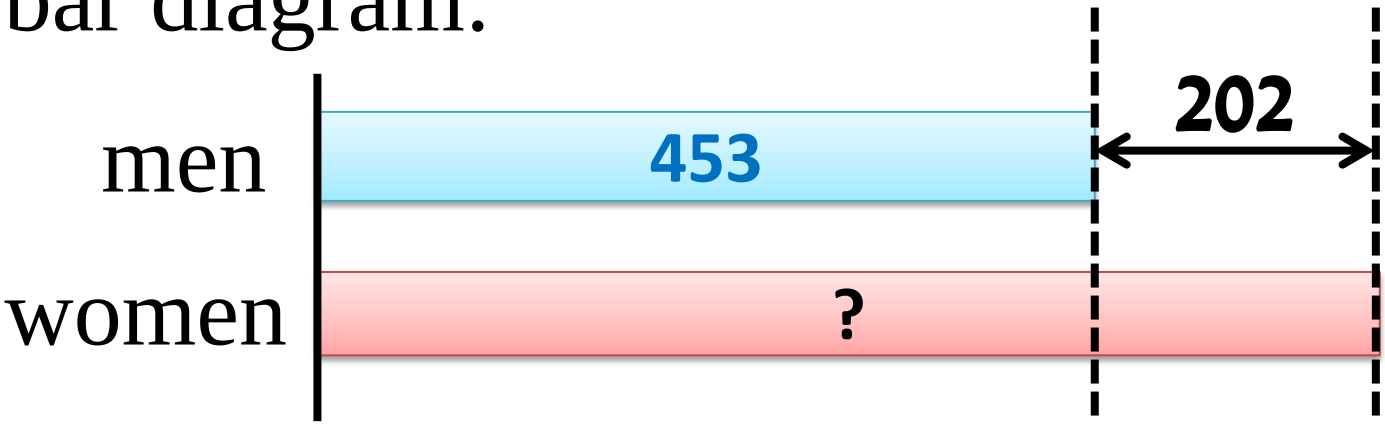
$$\begin{array}{r} 9\ \overset{7}{\cancel{8}}\ 2^{10} \\ -\ 3\ 0\ 3 \\ \hline 5\ \cancel{6}\ 7^{9} \\ -\ 4\ 8\ 2 \\ \hline 1\ 9\ 7 \end{array}$$

2.2.2 Box diagram(工序盒、入出圖)

1. ‘in’ , ‘out’ (+ and -)
2. ‘in’ , ‘in’ (+ and +)
3. ‘out’ , ‘out’ (- and -)

E.g. 453 men are on the train C.
There are 202 *fewer men* than women.
<u>How many people</u> are there on the train C?

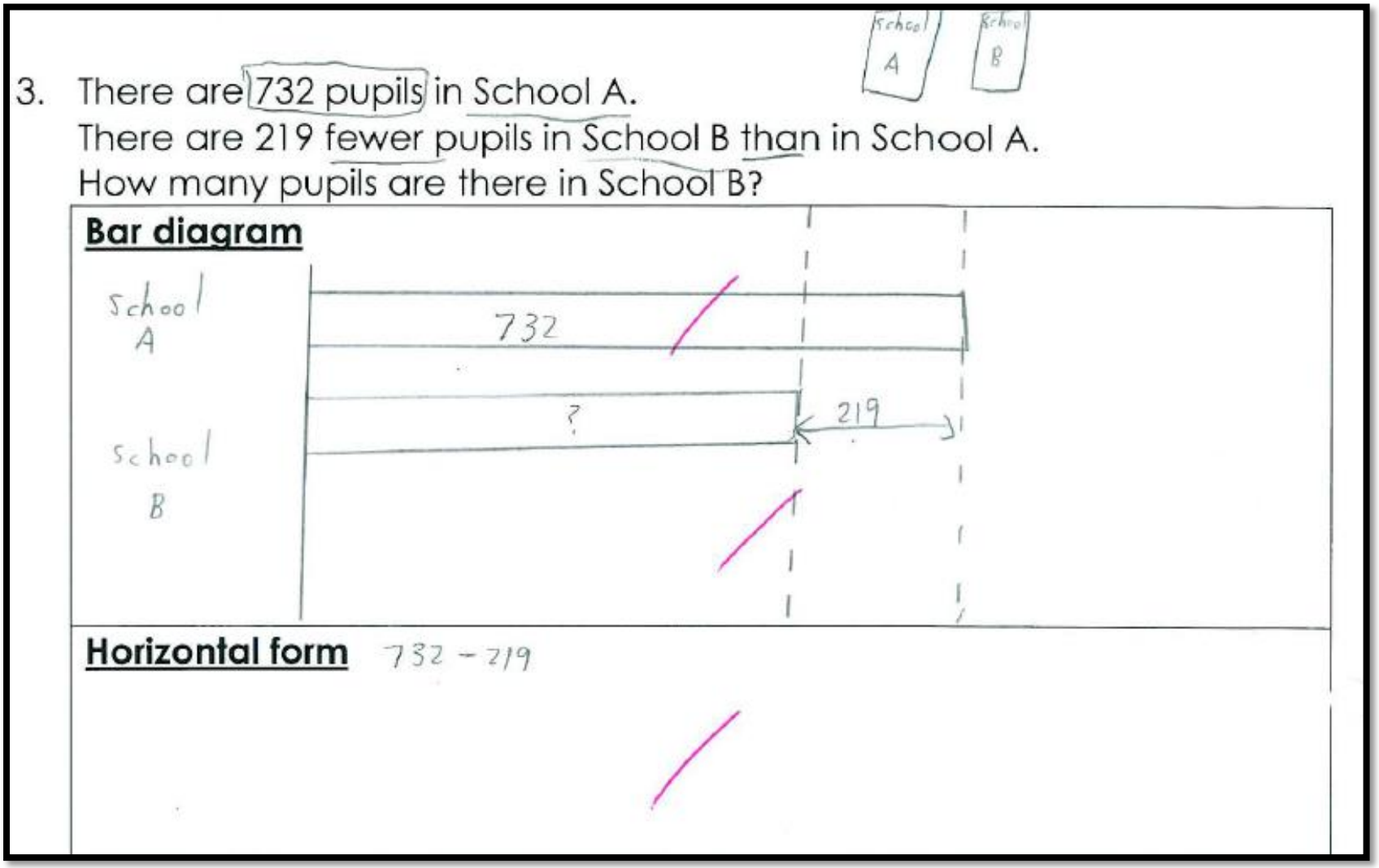
bar diagram:



women: 453 + 202

people: (453 + 202) + 453

Bar diagram – Students' work



3. There are 732 pupils in School A.
There are 219 fewer pupils in School B than in School A.
How many pupils are there in School B?

Bar diagram

Horizontal form 732 − 219

2.2.3 Bar diagram(線段圖)

1. For comparing quantities
2. To show which quantity is larger; or to show the quantities by relative size
3. To visualize the ‘difference’

2.3 P.3教程內容

教學目標：深化審題技巧、加強分析思考

教學內容：先分析，後橫式
(Analyzing questions before writing horizontal form)

具體步驟：

讀題讀兩次，

步驟一：第一次讀故事，

步驟二：第二次讀數字；

步驟三：繪畫思考圖。

Read the question text twice

- Step 1: Read the story
- Step 2: Read the number
- Step 3: Draw an Analytical diagram for the quantities

2.3.1 讀故事 Read the story

1. Introduce different story elements; help students learn the context or situation
   - People - Who?
   - Place - Where?
   - Time - When?
2. Identify the Items
   - what are we counting? respective units?
3. Study if there is any comparison ? Any grouping? (relation between quantities)
4. Clarify the question focus:
   - What are we asked to do?
   - What is/are required before we can give the answer?

2.3.2 讀數字 Read the numbers

- Read line-by-line
- Build a Data Table (資料表)
- Pay attention to hidden data (i.e. each, dozen, half a dozen, etc.)
- 逐句讀
- 建立資料表
- 留意隱藏數字(如:一周、半打、每一 …)

2.3.3 圖解分析 Analysis

- Draw Diagram to show the solution or the relation between quantities.
- 繪畫分析圖展示數量與數量之間的關係

2.3.4 P.3學生作業樣本

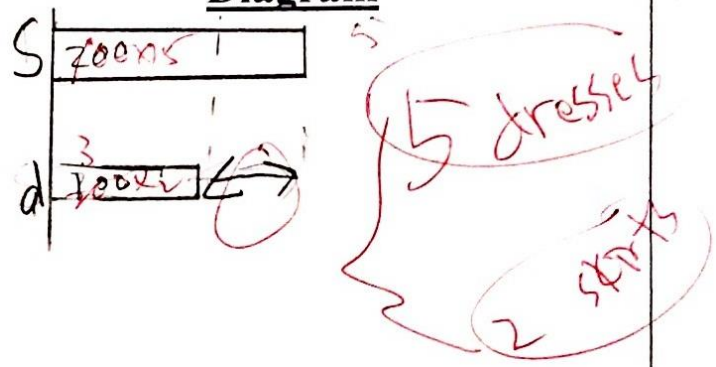
1. A dress costs 100 dollars and a skirt costs 200 dollars. How much more are 5 dresses than 2 skirts?

A

Data Table

A dress cost	$100
and a skirt cost	$200
How many more are	5 (d) than 2 (s)

Diagram



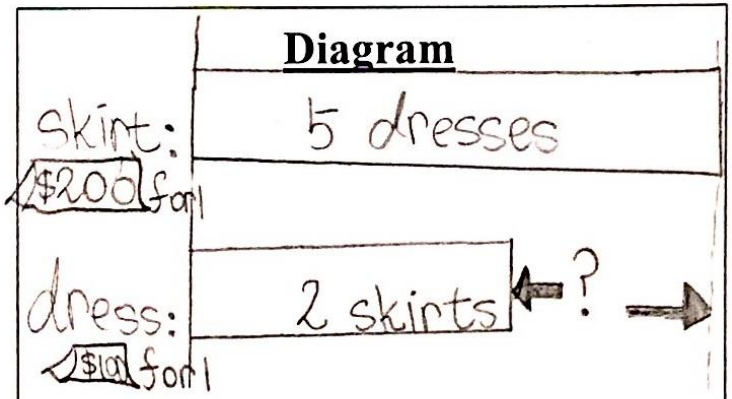
HF: 100x5-200x2=

B

Data Table

A dress	100 dollars
A skirt	200 dollars
How much more are 5 dresses than 2 skirts	?

Diagram



HF: (100x5)-(200x2)=

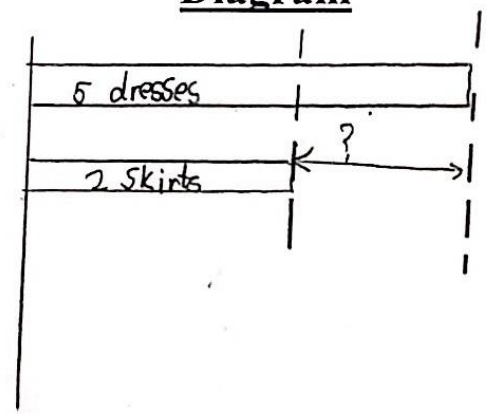
1. A dress costs 100 dollars and a skirt costs 200 dollars. How much more are 5 dresses than 2 skirts?

C

Data Table

A dress costs	100 dollars
A skirt costs	200 dollars
How much more are 5d then 2S	?
5dresses	$100x5
2 Skirt	$200x2

Diagram



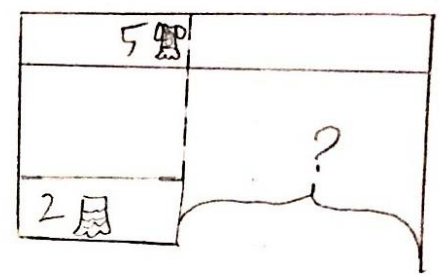
HF: (100x5)-(200x2)

D

Data Table

	$100
	$200
How much more are 5 than 2	?
5	$100x5
2	$200x2

Diagram



HF: (100x5)-(200x2) = 100

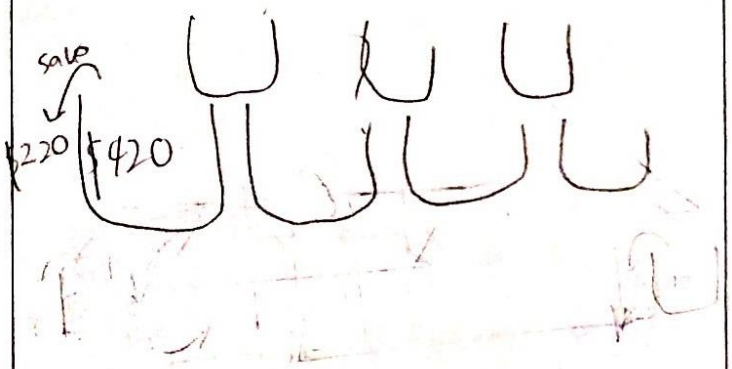
2. Mathis gets 420 dollars pocket money every day. Every day he saves 220 dollars. How much money does he spend in one week?

E

Data Table

get pocket money	$ 420
save	$220
spend in a week	?

Diagram



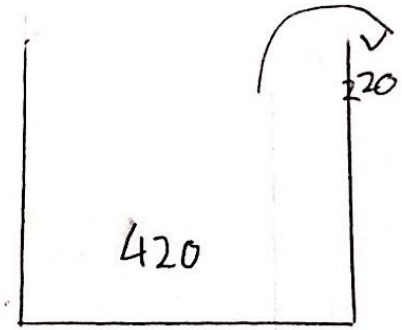
HF: (420-220)×7=

F

Data Table

Mathis gets	420 dollars
He saves	220 dollars
How much money does he spends in one week	?

Diagram



HF: (420-220)×7

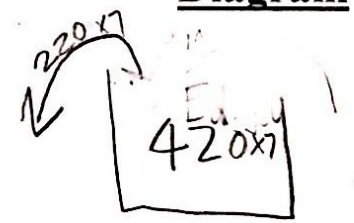
2. Mathis gets 420 dollars pocket money every day. Every day he saves 220 dollars. How much money does he spend in one week?

G

Data Table

Mathis gets	$420 ed
Ed Saves he	$220
He spend	? one week (7 day)

Diagram



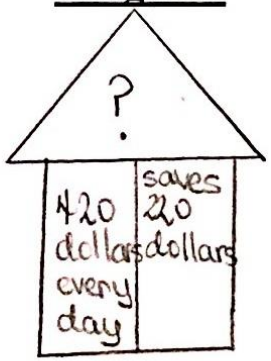
HF: (420x7-220)x7

H

Data Table

Mathis	gets 420 dollars pocket money every day
Every day Mathis	saves 220 dollars
How much money does he spend in one week	?

Diagram



HF: (420-220)x7=

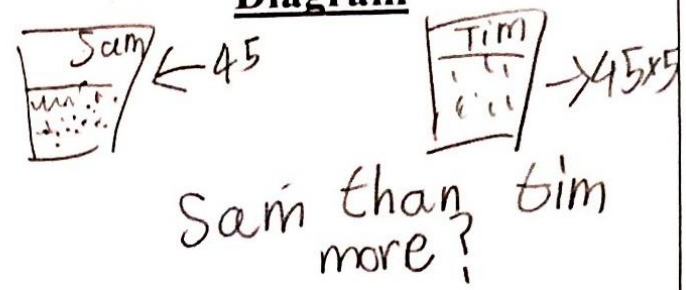
3. Sam has 45 cars. The number of cars Tim has is 5 times of Sam. How many less cars does Sam have than Tim?

A

Data Table

Sam has	45 cars
Tim has	45x5 =
less (S) than (T)	?
(T) than (S)	?

Diagram



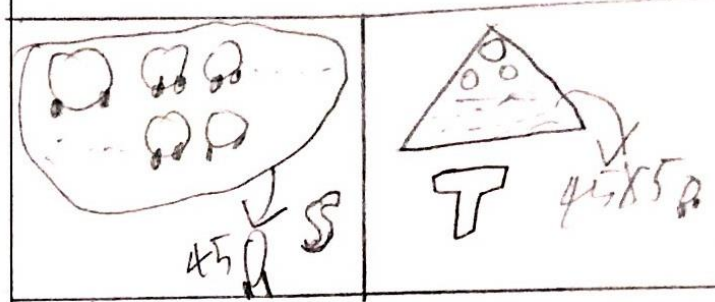
HF: (45x5) − 45 =

B

Data Table

S	45
T1	45x5
How many less does S have than T1	?

Diagram



T − S = ?

HF: 45x5 − 45 = 180

225

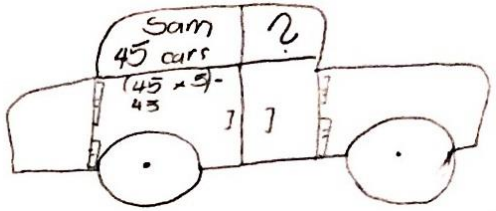
3. Sam has 45 cars. The number of cars Tim has is 5 times of Sam. How many less cars does Sam have than Tim?

C

Data Table

Sam	45 Cars
How many less cars does Sam have than Tim ?	?

Diagram



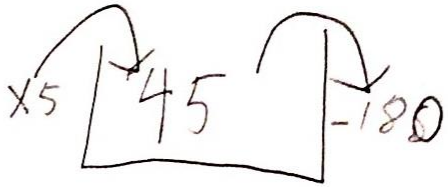
HF: (45×5)-45

D

Data Table

Sam	45
Tim	X5
Sam vs Tim	???
Tim.	???????

Diagram



HF: (45 X 5)-45=180

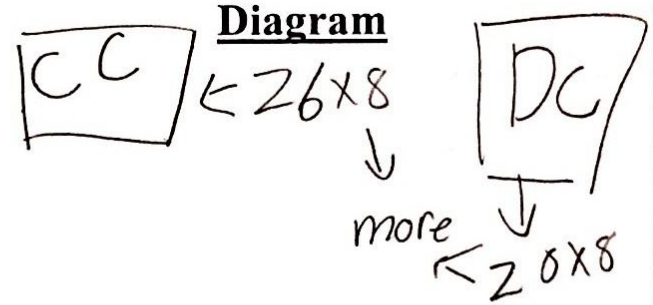
4. A box of chocolate cookies has 26 pieces and a box of durian cookies has 20 pieces. How many more pieces in 8 boxes of chocolate cookies are there than in 8 boxes of durian cookies?

E

Data Table

A box CC	26 pieces
A box DC	20 pieces
8 boxs CC than 8 boxes DC	??

Diagram



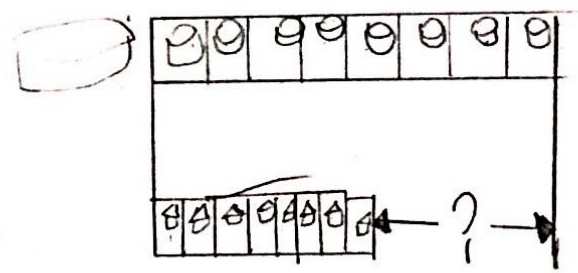
HF: (26x8) - (20x8) =

F

Data Table

Chips ahoi	26
Dutch	20
8 more than 8	?

Diagram



HF: (26-20)x8) = 48

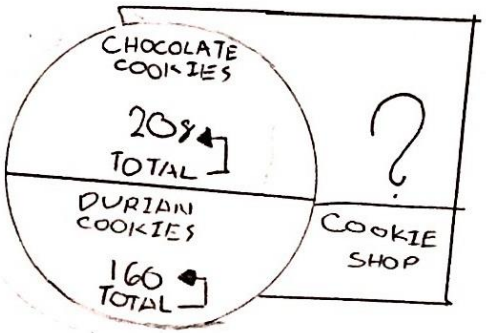
4. A box of chocolate cookies has 26 pieces and a box of durian cookies has 20 pieces. How many more pieces in 8 boxes of chocolate cookies are there than in 8 boxes of durian cookies?

G

Data Table

CHOCOLATE COOKIES	CALCULATION 208 $\begin{array}{r} 26 \\ \times\ 8 \\ \hline 208 \end{array}$
DURIAN COOKIES	160 CALCULATION $\begin{array}{r} 20 \\ \times\ 8 \\ \hline 160 \end{array}$
HOW MANY MORE PIECES IN 8 BOXES OF CHOCOLATE COOKIES ARE THERE THAN IN 8 BOXES OF DURIAN COOKIES	?

Diagram



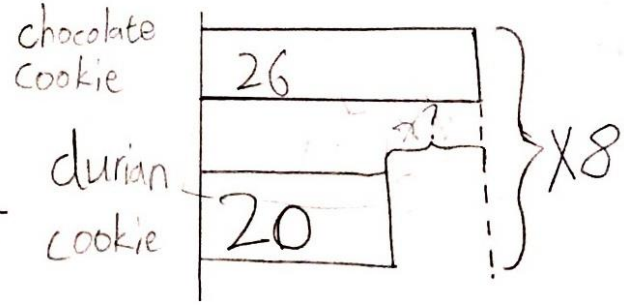
HF: (26 × 8) − (20 × 8)

H

Data Table

CC	26
dc	20
CC	×8
dc	×8
?	?
?	?

Diagram



HF: 26×8−20×8= 48

208 − 160

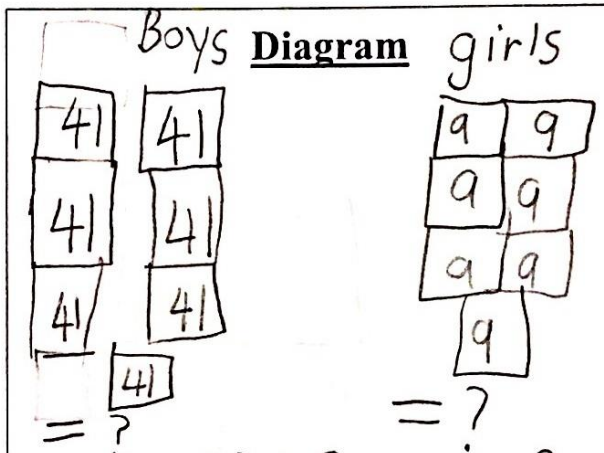
1. In a Mathematics competition, each team has 41 boys and 9 girls. How many students are there in 7 teams?

A

Data Table

Maths competition boys	41 boys
Maths competition girls	9 girls
Students in @ 7 teams	?

Diagram



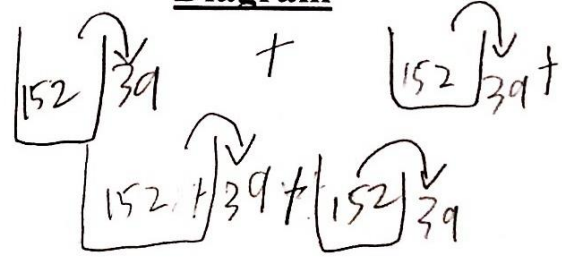
HF: (41x7) + (9x7) = ?

B

Data Table

worker made	14
@	152 @
staff packed	39 @
have now	?

Diagram



HF: (152-39)x4 = 452

113

1. In a Mathematics competition, each team has 41 boys and 9 girls. How many students are there in 7 teams?

C

Data Table

I a m C	41 bie't
I am C	9 giet
H m a ns i 7 t	?

Diagram

41b9G 41b9G 41b9G

41b 9G 41b9G 41b9G

41b9 G

HF: (41+9)x7

D

Data Table

boys	41 each team
girls	9 each team
How many students in 7 teams?	(41+9)x7
students	?

Diagram

41+9

Team x 7

HF:

E

Data Table

MC @ team has boys	41 bs each
How many boys are there in 7 teams.	???
MC @ team has girls	9 gs each

Diagram

Mc 41boys Each team has boys 41	Mc 41 boys Each team has boys 41	Mc 9grils Each team has 9 grils
How many boys ? are there in 7 teams?	How many boys? are there in 7 teams?	Mc 9grils Each team has grils 9

HF: (41+9)x7

2. A worker made 4 types of watches of 152 pieces each. A staff packed 39 pieces from each type and sent them to a shop. How many pieces of watches does the worker have now?

A

Data Table

worker made	4
@	152 @
staff packed	39 @ @
have now	?

Diagram

152 39 + 152 39 + 152 + 39 + 152 39

HF: (152-39)x4 =452

P.1

B

Data Table

A worker made types of @	4 typer
how many Pieces @	152 pieces
A staf packed type of pieces to shop	39 pieces @
How many Pieces he have now	?

113

Diagram

152
152
152 +39 =?
152

HF: 152x4+39 =?

2. A worker made 4 types of watches of 152 pieces each. A staff packed 39 pieces from each type and sent them to a shop. How many pieces of watches does the worker have now?

C

Data Table

Types	4
pieces	152 each
packed	39 each typs
Have now?	?

Diagram

152x4 → 39x4

HF: 152x4-39x4

Data Table

A w m to w	4
@ w o w	152
A s p f t	39
H m d t w h n	?

Diagram

4x152 → 39x4

HF: (152x4)-39 x4

D

A made types of	4 types of
A x38 sent to the shop	39 packed
How many does the have now?	???

E

Diagram

A made x3 types of watches	How many does the have now.
A packed 39 pieces from each type sent to shop	

HF: 152-39 x4

3. A toy car costs 570 dollars in shop A and 830 dollars in shop B. If Mrs Wong buys 3 toy cars from shop A, how much money can she save?

A

Data Table

ugly toy car $570 in A	ugly toy car $830 in shop B
→ buy → 3 toy cars from shop A	3
How much money can she save	?

Diagram

Shop B
830x3dollars

Shop A
570x3dollars ?

HF: 830X3−570X3

B

Data Table

shop A A toy car cost	$570 dollars
shop B toy car cost	$830 dollars
Mrs Wong buys	3 in shop A
How much she save	? ?
3 in Shop A	$570X3
3 in Shop B	$830X3

Good Point

Diagram

Shop A: $570

Shop B: $830

How much can she save?

??? ?

0

HF: (830X3) − (570X3)

3. A toy car costs 570 dollars in shop A and 830 dollars in shop B. If Mrs Wong buys 3 toy cars from shop A, how much money can she save?

C

Data Table

a toy car Shop A	costs 570 dollars
a toy car Shop B	costs 830 dollars
Mrs Wong	buys 3 toy cars from shop A
how much money can she save	?

Diagram

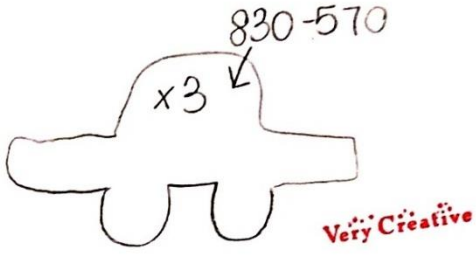
HF: (830-570)-(570x3)=

D

Data Table

Shop A	$570
Shop B	$830
Mrs Wong	Buys 3 Shop A
Save	?

Diagram

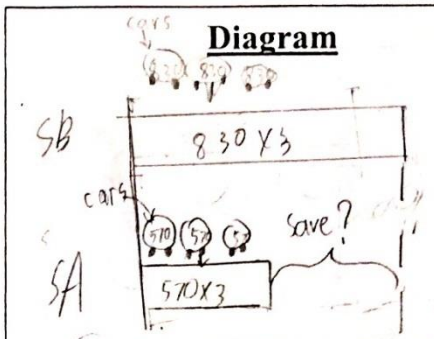


HF: (830-570)x3

E

in shop A	$570
in shop B	$830
Mrs Wong buy	3 in SA
save	$?

Diagram



HF: (830-570)x3=180

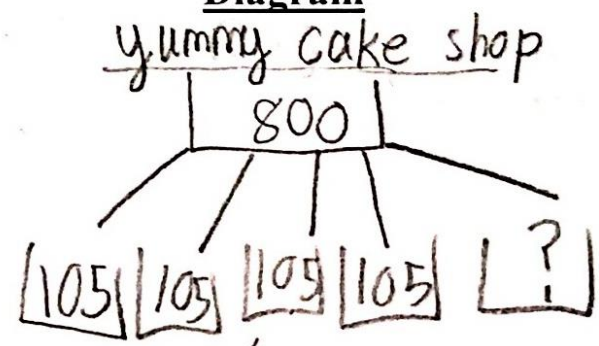
4. There are 800 branches of Yummy Cake Shop in five districts. There are 105 branches in each of the four districts. The remaining branches are in the fifth district. How many branches are there in the fifth district?

A

Data Table

districts 1	105
district 2	105
district 3	105
district 4	105
districts	?

Diagram



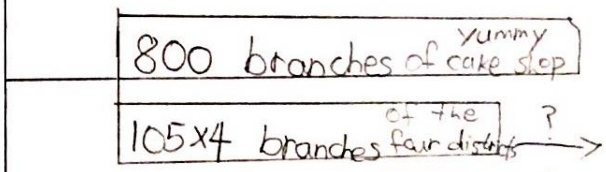
HF: 800−(105×4)

B

Data Table

There are	800 branches of yummy cake shop in five districts.
There are	105 branches in each of the four districts.
How many branches are there in the	fifth district

Diagram



HF: 800−105×4

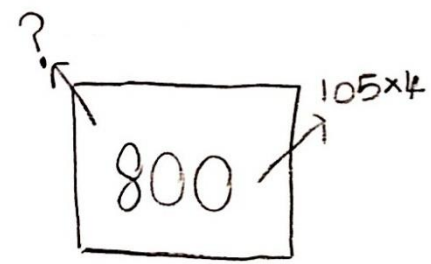
4. There are 800 branches of Yummy Cake Shop in five districts. There are 105 branches in each of the four districts. The remaining branches are in the fifth district. How many branches are there in the fifth district?

C

Data Table

Total Branches	800
4 districts	105 each
5th district	?

Diagram



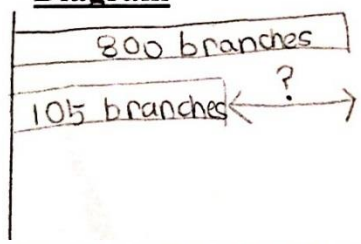
HF: 800-(105x4)

D

Data Table

Yummy Cake shop	800 branches in 5 districts
There are	105 branches in each of the four districts
Remaining branches are fifth district	?
How many branches are there in the fifth district	?

Diagram



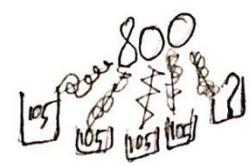
HF: (

E

Data Table

no. of Ys	5
no. of Bs in 4 ds	105 each
no. of B in 5th ds	?
no. of Ys B in	800

Diagram



HF: 800-(105x4)=380

2.3.5 促進學習的回饋 Giving Feedback

回饋重點

- 準確 Accuracy
- 數量之間的關係 Relations
- 精簡用字 Economy of words
- 原創、創意 Creativity

* 提供安全學習環境，鼓勵表達，強調沒有標準答案
* Positive encouragement
* No absolute answer

2.4 教學規劃及細節

- 利用應用題引入計算方法
- 教授算式題計算技巧和方法
- 持續算式題及文字算題練習
- 審題、分析教學**
- 應用題全題解

#建議堂數:18節

**具體課堂
- 算式題熱身
- 應用題教學
  - 資料表
  - 思考圖
- 鞏固練習
- 總結

2.4.1 數學語言元素(補充)

Language Element

left	more	altogether	fewer	Spend/ spent
give	sell / sold	change	cheaper	Total
difference	Buy/ bought	save	use	Shorter
compare	Take away	Half fares	Full fares	amount
How many more		How many fewer		

11 is 3 (more / less) than 8.

7 is 6 (more / less) than 13.

目錄

2.5 成效檢視(學生問卷分析)

2.5.1 Questionnaire

1.	**I commit to read carefully the question and express truly my view and thought.**							
a.	**Yes, I will. b. No, I don't want to express myself in this questionnaire.**							
2.	**I am good at Mathematics.**							
	(very weak)	**1**	**2**	**3**	**4**	**5**	**6**	**(very good)**
3.	**I enjoy doing numeric calculation. E.g. Calculate 327 x 4**							
	(dislike doing)	**1**	**2**	**3**	**4**	**5**	**6**	**(like doing calculation)**
4.	**I like solving word problems.**							
	(find them difficult)	**1**	**2**	**3**	**4**	**5**	**6**	**(like to take challenge)**
5.	**What are the steps before writing the Horizontal Form? (Write as far as you know.)**							
6.	**It is easy to build a data table.**							
	(I find it difficult)	**1**	**2**	**3**	**4**	**5**	**6**	**(I do it very well)**
7.	**I like to build a data table.**							
	(strongly dislike)	**1**	**2**	**3**	**4**	**5**	**6**	**(enjoy building)**
8.	**It is easy to build a GOOD data table.**							
	(I find it difficult)	**1**	**2**	**3**	**4**	**5**	**6**	**(I can build good tables)**

2.5.1 Questionnaire

9.	**It is easy to draw diagram for a question.**							
	(I find it difficult)	**1**	**2**	**3**	**4**	**5**	**6**	**(I do it very well)**
10.	**I like to draw diagram for a question.**							
	(strongly dislike)	**1**	**2**	**3**	**4**	**5**	**6**	**(enjoy drawing)**
11.	**It is easy to draw a GOOD diagram for a question.**							
	(I find it difficult)	**1**	**2**	**3**	**4**	**5**	**6**	**(I can draw good ones)**
12.	**We read a question twice. Step 1 we read the story and, step 2 read the number.**							
I think:	**(NO need to read story)**	**1**	**2**	**3**	**4**	**5**	**6**	**(read story is Important)**
13.	**To build a data table is helpful for me to understand the question.**							
	(strongly disagree)	**1**	**2**	**3**	**4**	**5**	**6**	**(strongly agree)**
14.	**The data table is useful for me to write a correct horizontal form.**							
	(no use)	**1**	**2**	**3**	**4**	**5**	**6**	**(very useful)**
15.	**To draw a diagram is helpful for me to analyse the question.**							
	(strongly disagree)	**1**	**2**	**3**	**4**	**5**	**6**	**(strongly agree)**
16.	**The diagram is useful for me to write a correct horizontal form.**							
	(no use)	**1**	**2**	**3**	**4**	**5**	**6**	**(very useful)**

2.5.1 Questionnaire

17. When I do word problems (of medium difficulty) at home, and it is not a MUST to build table or draw diagram,

- **a. I will go straight to write the horizontal form**
- **b. I will only build a data table before writing the horizontal form**
- **c. I will only draw diagram before writing the horizontal form**
- **d. I will do both and then the horizontal form**

18. When I do difficult word problems during examination, and it is not a MUST to build table or draw diagram,

- **a. I will go straight to write the horizontal form**
- **b. I will only build a rough data table before writing the horizontal form**
- **c. I will only draw crude diagram before writing the horizontal form**
- **d. I will do both and then the horizontal form**

19. When I learn to solve more complicated word problems next year (in P.4)

- **a. I prefer teacher straightly teaches us the horizontal form and the calculation.**
- **b. I wish teacher teaches us further skills to build data table before writing the horizontal form**
- **c. I wish teacher teaches us further skills to draw diagram before writing the horizontal form**
- **d. I wish teacher teaches us both and then the horizontal form**

After I learned building table and drawing diagram for a question.

20. I know how to analyse a word problem							
(I have NO confidence)	**1**	**2**	**3**	**4**	**5**	**6**	**(I am confident)**
21. My word problem solving skills:							
(NO change)	**1**	**2**	**3**	**4**	**5**	**6**	**(Improved a lot)**
22. I am a better thinker now.							
(I don't think so)	**1**	**2**	**3**	**4**	**5**	**6**	**(Yes, I am)**

2.5.2 學生對建立資料表的態度

Q6. 建立資料表

我感到困難 ⟷ 我做得很好

9	8	11	23	38	30

Q7. 我喜歡建立資料表

很不喜歡 ⟷ 喜愛建立

10	10	22	19	15	46

Q8. 建立好的資料表

我感到困難 ⟷ 我能做得好

7	13	19	29	23	30

2.5.2 學生對繪畫分析圖的態度

Q9. 繪畫分析圖

我感到困難 ⟷ 我做得很好

11	13	27	26	22	22

Q10. 我喜歡繪畫分析圖

很不喜歡 ⟷ 喜愛繪畫

14	22	16	24	19	26

Q11.繪畫好的分析圖

我感到困難 ⟷ 我能做得好

11	13	16	33	28	20

2.5.2 資料表 vs 分析圖

Q7. 我喜歡建立資料表

很不喜歡

10	10	22	19	15	46

喜愛建立

Q10. 我喜歡繪畫分析圖

很不喜歡

14	22	16	24	19	26

喜愛繪畫

推論：

1. 學生普遍認為建立資料表較易接受和掌握
2. 繪畫分析圖有一定難度

2.5.3 讀故事的重要性

Q12. 讀題需要閱讀兩次，

第一次讀故事，

第二次讀數字。

我認為：

無需要讀故事 ⟷ 讀故事很重要

0	2	6	15	21	77

推論：

1. 絕大部分學生認同讀故事的重要性
   (校本應用題教程的重要成果之一)

2.5.4 資料表和分析圖的輔助作用

Q13.資料表有助理解題目

很不同意

4	8	10	23	26	51

非常同意

Q14.資料表有助列寫橫式

沒用處

5	9	12	24	24	45

很有幫助

Q15.分析圖有助理解題目

很不同意

6	10	14	23	27	39

非常同意

Q16.分析圖有助列寫橫式

沒用處

7	8	11	32	25	38

很有幫助

推論：

1. 學生普遍認同資料表和分析圖對解題和列寫橫式具實質幫助(重要成果之二)

2.5.5 學生對思考工具的運用與評價

在沒有明確要求下：

	直接列寫橫式	只建資料表	只繪分析圖	建表及繪圖
Q17. 做家課時	35	26	13	44
Q18. 測考時	49	22	13	37

	直接教授橫式	只教授建表	只教授繪圖	教授表和圖
Q19. 明年P.4，希望老師	26	27	18	49

推論：

1. 超過一半學生認為在測考時，仍須在列寫橫式前，多做一點解難分析工作
2. 縱然學生在測考時不一定運用有關技巧，但普遍學生確認老師教授相關技巧的需要

2.5.6 學生對自我能力的評估

學習了從題目中掌握題意，
建立資料表和繪畫分析圖後：

Q20. 我懂得分析文字應用題	我沒有信心	7	8	16	38	25	28	我信心十足
Q21. 我的解題技巧	沒有改進	6	11	25	31	19	30	進步很大
Q22. 我現在成了更會思考的人	我不認為	4	6	15	33	27	37	對！我正是

推論：

1. 經歷教程以後，大部分學生對解答應用題的信心有提升(重大成果之三)
2. 從觀察學生作業所得，學生展示他們的多元和多樣的解答方案，相對過往標準橫式的單一要求，顯示出答案是學生的主動思考成果，而非被動的配合要求。因此，大多數學生確認自己的思考能力提高，成了一個更會思考的人(重大成果之四)

2.5.7 稍遜學生的問卷分析和啟示

Q2	Q3	Q4	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22
1	6	1	3	3	2	3	1	6	6	5	1		5	d	d	d	2	2	1
1		1	1	1	1	2	6	1	6	6	6	1	6	b	a	d	6	1	1
1	3	2	5	2	3	3	2	2	3	2	2	1	1	b	b	a	4	2	2
1	5	3	1	6	1	3	6	3	4	4	3	4	4				5	6	6
1	6	6	6	6	6	5	5	5	6	6	5	5	5	c	a	b	5	4	4
2	2	1	3	4	3	3	4	3	6	6	6	6	6	c	c	d	3	2	2
2	2	1	5	4	3	2	2	2	4	3	3	2	2	b	a	c	2	3	3
2	3	1	4	4	2	3	2	3	4	4	3	3	4	b	b	d	4	3	2
2	5	3	4	3	4	3	5	4	5	5	4	4	4	d	b	c	4	4	4
2	4	4	5	5	5	5	4	4	6	5	6	5	4	b	c	d	4	4	4
2	6	4	3	6	4	3	2	4	6	6	6	5	5	d	d	d	5	4	6
3	1	1	5	2	4	3	4	2	5	3	3	3	2	c	a	b	2	4	6
3	1	1	6	6	6	6	6	6	5	6	6	6	6	d	d	d	6	6	6
3	3	1	6	6	6	3	4	1	6	5		3	2	b	c	b	3	2	6
3	4	1	3	4	1	4	3	4	6	4	4	3	4	d	d	b	4	3	4
3	4	1	5	3	3	2	1	3	3	3	4	2	4	b	d	a	3	2	5
3	4	1	5	6	6	4	4	6	6	6	6	5	6	d	b	b	4	3	3
3	5	1	1	6	6	3	6		6	5	6	6	6	d	a	a	1	3	5
3	5	1	2	3	4	2	6	4	6	6	6	6	5	c	b	b	4	3	4
3	5	1	6	5	6	2	2	1	6	6	5	3	2	b	b	c	6	1	4
3	6	1	4	6	4	3	3	1	6	5	2	6	4	b	a	a	5	3	6
3	6	1	5	6	3	5	3	4	6	5	5	2	3	d	a	d	6	3	4

Q2. 我的數學能力

Q4. 我愛挑戰應用題

Q7. 我喜歡建表

Q13. 建表有助解題

Q19. 希望教授表和圖

Q20. 有信心答應用題

Q22. 我是思考人

推論：(稍遜學生 ~ 自評數學能力偏低，害怕解答應用題)

1. 逾半稍遜學生對解答應用題的信心有所提升
2. 大部分均認為自己的思考能力提高，成了一個更會思考的人

2.5.8 數學能力高學生的問卷分析和啟示

Q2	Q3	Q4	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22
5	6	5	4	2	4	3	2	4	4	2	1	2	2	a	a	a	5	6	6
5	6	5	5	5	6	5	5	6	6	6	6	6	6	d	d	a	5	4	5
5	6	5	6	6	6	6	6	6	6	6	6	6	6	b	b	d	6	6	6
5	3	6	6	6	6	6	6	6	6	6	5	6	6	a	a	d	6	6	6
5	4	6	4	5	4	5	4	4	6	4	4	6	3	c	c	d	4	5	4
5	6	6	5	5	5	5	5	5	5	6	5	5	5	a	a	a	5	6	6
5	6	6	5	6	6	5	5	6	6	6	6	6	6	d	d	d	6	6	6
5	6	6	6	5	6	6	6	6	6	6	6	6	6	d	d	d	5	6	5
6	6	3	1	3	2	6	6	5	4	2		6		a	d	b	4	6	1
6	6	3		6	6	6	6	6	6	6	6	6	6	d	d	d	6	6	6
6	5	4	5	4	5	2	2	3	6	5	4	3	2	b	a	d	3	2	3
6	6	5	6	6	6	3	4	5	6	6	6	6	6	d	d	b	6	6	6
6	5	6	6	3	4	6	1	6	6	3	1	4	3	a	d	a	6	6	6
6	6	6	5	4	5	5	5	5	6	5	5	4	4	a	a	c	6	6	6
6	6	6	6	1	6	1	1	6	6	6	6	6	6	a	a	a	6	6	6
6	6	6	6	1	6	6	1	4	6	1	1	1	1	a	a	a	6	6	1
6	6	6	6	6	6	6	6	6	6	6	6	5	6	a	a	b	1	1	6
6	6	6	6	6	6	6	6	6	6	6	6	6	6	d	d	d	6	6	6
6	6	6	6	6	6	6	6	6	6	6	6	6	6	d	d	d	6	6	6
6	6	6	6	6	6	6	6	6	6	6	5	1	4	a	b	a	6	6	6
6	6	6	6	6	6	6	6	6	6	6	6	6	6	b	d	b	6	6	6

Q2. 我的數學能力

Q4. 我愛挑戰應用題

Q13. 建表有助解

Q16. 繪圖有助寫橫式

Q18. 測考也用表和圖

Q19. 希望教授表和圖

Q21. 自覺有很大改進

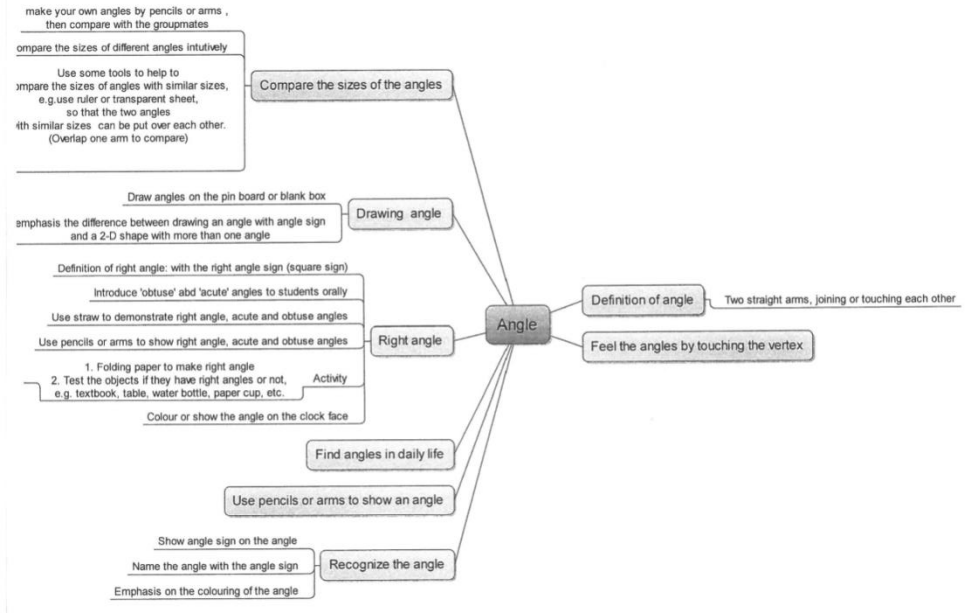
推論：(能力高學生 ~ 自評數學能力高，愛挑戰應用題)

1. 能力高學生對建表和繪圖的歡迎和抗拒的態度參半
2. 大部分均認為自己的思考能力仍有所改進

目錄

2.6 教師的反思

學生	家長	教師
• 口述能力 • 畫圖能力 • 堂課、家課、評估	• 功課量 • 圖像思考工具是一項挑戰，需要時間適應	• 了解學生所需，度身訂造題目 • 共同數學語言，增加學生與老師在數學上的溝通 • 視像解釋更清晰易明 • 每2星期一次的共同備課，教師專業發展



2.7 數學科展望

第一學習階段

- 接近完成發展的審題和分析教程
- 來年，將完善教程的編排
- 訂定按步進階的計算訓練
- 加強學生認識數學中的語言元素，和數學表述能力

即將進入第二學習階段的學生，他們的思考態度已見很大改善，並且已學會了一些審題和分析的方法。

期待在高年級處理較艱深的課題時，老師能透過前述的工具，掌握學生的思考，準確溝通數學概念和複雜情境，從而改善教學成效。

目錄

3 總結：思考教學與數學教學

(A Thinking Math Curriculum)

3.1 現在看得到的思考

- 直式計算
- 橫式演算（帶分數加減）
  - 教師能具體地看到學生的進位、退位、擴分、約分等計算思考

看不到的：

- 學生的思考步驟或次序
- 學生對問題的認識程度
- 如何從文字中得出數字算式
- 哪個思考環節對了？哪個環節開始出錯?

3.2 香港學生數學學習的總體表現

- 看得到的計算
  - 非常優異
- 看不到的思考
  - （解難思考）明顯偏弱

問一：

我們既是看不到學生怎樣思考，又能從哪裡指導和幫助他們學習思考呢?

問二：

解難思考既是看不到，學生在做練習的過程中，到底有沒有真的鍛鍊和改進他們的思考能力呢?

3.3 看不到還是看得到

- 學生的思考步驟或次序
- 學生對問題的認識程度
- 如何從文字中得出數字算式
- 哪個思考環節對了？哪個環節開始出錯?

經過教程以後，上述的思考能看得到嗎?

3.4 能與不能

問一：我們既是看不到學生怎樣思考，又能從哪裡指導和幫助他們學習思考呢?

答：　**看到了學生的思考以後，就能給予適切的指導。**

問二：解難思考既是看不到，學生在做練習的過程中，到底有沒有真的鍛鍊和改進他們的思考能力呢?

答：　**把解難思考變成具體的解題步驟**，學生就有確實而充分的思考鍛鍊，從而改進他們的思考能力。

3.5 持續發展需要系統地推行

- 調適課程內容和調動教程，以騰出教節聚焦教授審題分析思考

- 數範疇的單元內容重訂，並分拆教授
  - 算式題 +文字題 + (技巧純熟訓練)
  - (應用題/情境題)審題+分析思考

3.6 數學老師對數學教育的再思

- 相信學生的思考能力
- 發展學習能力和態度比學會課題知識更重要
- 關注提供安全的學習環境，適時給予支持、幫助建立自信
- 給予時間做思考和表述 – 不一定是課堂時間

- Having Faith that all students Can Think
- Developing Intelligent Behaviour as the Goal of Education
- Creating a Safe Risk-taking Environment
- Giving it Time when we are to teach Thinking.

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