Education Bureau
School-based Curriculum Development (Secondary) Section
2024/25 School Year

Promoting Students' Active Learning through Interactive Instructional Model

SKH Bishop Mok Sau Tseng Secondary School

School background

Mathematics Programme Plan (2024/25)

To enhance learning effectiveness

- Develop a collaborative culture in learning

- Embrace learner diversity and stretch students' potential to the fullest

- Foster students' interest and enrich their knowledge in Mathematics education

School-based support collaboration

As our school would like to promote learning and teaching through improving quality of questioning and feedback, we would like to investigate various intructional model in our lesson, then facilitate professional dialogue through collaborative lesson planning and lesson observation.

For our school, students are hardworking and interested in mathematics. However, they lack the confidence to articulate their ideas and engage in discussion with teachers and classmates. They are also not very good at communicate mathematics ideas in mathematical language.

Therefore, we would like to provide opportunities for teachers to teach mathematics using different approaches. It is a good opportunity for students to participate more in their lessons to learn and discuss under the new instructional model.

Focus of collaboration: Promoting students' active learning through interactive instructional model

Curriculum planning

Discussion on the support level and identify students' learning difficulties

▶ Support level: S2

▶ Students' learning difficulties:

(1) Weak in problem solving of learning units "Rates, Ratios, and Proportions" and "Linear Equations in Two Unknowns".

(2) Hard to apply prior knowledge in real life situations.

▶ Different learning and teaching approaches were discussed in the meeting

(1) "Rates, Ratios, and Proportions" - 5E instructional model to initiate one question with multiple solutions and develop number sense in checking reasonable answers

(2) "Linear Equations in Two Unknowns" - Inquiry-based learning to facilitate students creating application problems based on provided rubrics, with feedback from peers and teachers, they adjusted and monitored their learning progress.

Learning and teaching strategies - 5E instructional model

Phase	Summary
Engagement	The teacher or a curriculum task accesses the learners' prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities.
Exploration	Exploration experiences provide students with a common base of activities within which current concepts (i.e., misconceptions), processes, and skills are identified and conceptual change is facilitated. Learners may complete lab activities that help them use prior knowledge to generate new ideas, explore questions and possibilities, and design and conduct a preliminary investigation.
Explanation	The explanation phase focuses students' attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviors. This phase also provides opportunities for teachers to directly introduce a concept, process, or skill. Learners explain their understanding of the concept. An explanation from the teacher or the curriculum may guide them toward a deeper understanding, which is a critical part of this phase.
Elaboration	Teachers challenge and extend students' conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information, and adequate skills. Students apply their understanding of the concept by conducting additional activities.
Evaluation	The evaluation phase encourages students to assess their understanding and abilities and provides opportunities for teachers to evaluate student progress toward achieving the educational objectives.

The BSCS 5E Instructional Model: Origins and Effectiveness (Bybee et al., 2006)

Learning and teaching strategies
Rates, Ratios, and Proportions - 5E instructional model

Task 1: Pre-lesson task

Identify key concepts and guiding questions in each stage.

Engage: How to find the most cost effective goods in the supermarket? Collect data from internet and supermarket.

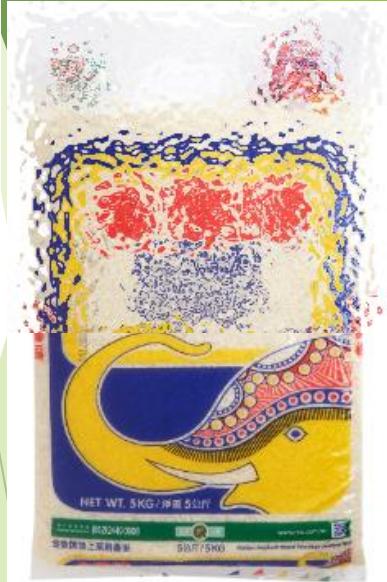**Explore**: There are different packages in the supermarket. Facing problems: Need to find the price rate to compare. How?

Explain: Students explain their ideas in comparing the prices. $/units or units/$, which is better?
Why the unit price is smaller for larger quantity?
Is it always better to buy goods which have larger quantities?

Task 2

255 g   327 g

Learning and teaching strategies
Rates, Ratios, and Proportions - 5E instructional model

Identify key concepts and guiding questions in each stage.

Elaborate: How to extend your idea to the more complicated situation?
- Task 3 – Buy souvenirs in local shop and online shop
- Task 4 – Exchange different currencies with bid rate/offer rate

Task 3

Mr. Cheung is a big fan of Chiikawa. He wishes to buy some Chiikawa souvenirs for his students and he looks for some shops in Hong Kong and Japan.

In local shop A,

In online shop B,

A set of 2 Chiikawa pouches is sold at HKD350.

A set of 3 Chiikawa pouches is sold at JPY10000 .

Task 4

During the Christmas Holiday, Mr. Ng went to Australia. He planned to use HKD$80000 in the whole trip.

現鈔
商戶買入

現鈔
商戶賣出

bid rate (買入價) ; the bid price is what an exchange shop is willing to pay for a foreign currency (e.g. AUD here).

Offer / Ask rate (賣出價) ; the ask price is the rate at which an exchange shop will sell the foreign currency (e.g. AUD here).

澳元   4.96000   5.01000
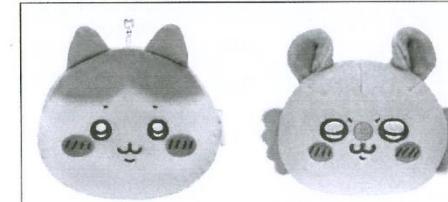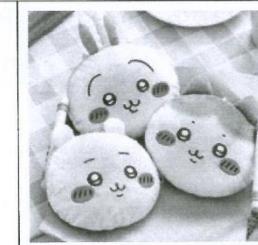
means 4.96 HKD / AUD

means 5.01 HKD / AUD

Evaluate: How to assess students' abilities in applying the concepts of rate in the other daily life scenario: Speed, tax rate, heart rate etc..

Student performance

Pre-lesson task

Assigned item : ___potato chips___

Price of the item in different packages / quantities.

(Reminder: the item should be in the same quality)

	Price (e.g. $24 for 6 packs, $50 for 8 kg, etc.)	Source (e.g. 7-11, HKTV mall, Wellcome)
Way 1	$ __19.9__ for __110g__ .	HKTV mall
Way 2	$ __19__ for __102g__ .	HKTV mall
Way 3 (if any)	$ _____ for _____ .	
Way 4 (if any)	$ _____ for _____ .	

If you have to purchase that item, which one will you choose? Why?

Task 1

(a) Your group has completed the pre-lesson task. Let's fill in the data that your group has collected.

Selected Item: __Potato Chips__

Way 1	Way 2	Way 3 (if any)
$ _19.9_ for ___110g___	$ _19_ for ___102g___	$_____ for _____

(b) To you, which one is a more cost-effective choice? Why? Explain your answer.

Way 1 :
$$\frac{19.9}{110}$$
$\approx \$0.181/g$.

Way 2 :
$$\frac{19}{102}$$
$\approx \$0.186/g$.

∴ $\$0.181/g < \$0.186/g$.

Way 1 < Way 2

∴ Way 1 is a more cost-effective choice.

We can make use of __division__ to find out __unit price__

Students collected the data about the prices of different packages of commodities in the supermarket and calculate the unit price for comparison

Student performance

Task 2

Mr. Tsang encountered some problems during shopping. Using what you have learnt in Task 1, please suggest a more cost-effective way of purchasing the items for him.

Problem (a)

In a pharmacy, the pills named "COLTALIN-ND" are sold at two different ways,
(i) $102.5 for 24 pills,
(ii) $150.9 for 36 pills.

Problem (b)

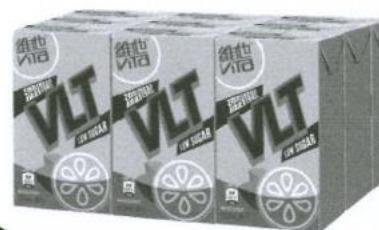In the online shop of Lee Kum Kee, premium oyster sauce is sold at
(i) $29.9 for 327 g,
(ii) $22.9 for 255 g.

Problem (c)

VITA lemon teas are sold at
(i) $20 for 6 packs (250 mL each),
(ii) $28 for 6 packs (375 mL each).

In each problem, which choice should Mr. Tsang pick? (i) or (ii)?

(a) Price rate in (i)

$$= \$102.5 \div 24$$
$$= \$4.27 / \text{pill}$$

Price rate in (ii)

$$= \$150.9 \div 36$$
$$= \$4.19 / \text{pill}$$

$$\$4.27 > \$4.19$$

∴ He should pick option (ii).

(b) Price rate in (i)

$$= \frac{29.9}{327}$$
$$= \$0.091/g$$

Price rate in (ii)

$$= \frac{22.9}{255}$$
$$= \$0.090/g$$

$$\$0.091/g > \$0.090/g$$

∴ He should pick option (ii).

(c) Price rate in (i)

$$= \frac{20}{6 \times 250}$$
$$= \frac{20}{1500}$$
$$= \$0.013/mL$$

Price rate in (ii)

$$= \frac{28}{6 \times 375}$$
$$= \frac{28}{2250}$$
$$= \$0.012/mL$$

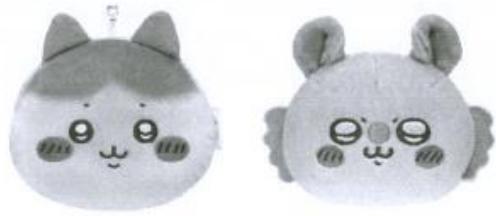$$\$0.013/mL > \$0.012/mL$$

∴ He should pick option (ii)

Students applied the concepts in different scenarios and explain their ideas in lesson

Student performance

Task 3

Mr. Cheung is a big fan of Chiikawa. He wishes to buy some Chiikawa souvenirs for his students and he looks for some shops in Hong Kong and Japan.

In local shop A,

In online shop B,

A set of 2 Chiikawa pouches is sold at HKD350.

A set of 3 Chiikawa pouches is sold at JPY10000.

(a) Find the price of Chiikawa pouch offered by local shop A in HKD / piece.

(b) Find the price of Chiikawa pouch offered by online shop B in JPY / piece.

(c) If the exchange rate between HKD and JPY is 0.051 HKD / JPY, is it cheaper to buy the Chiikawa pouches in local shop A? Explain your answer.

(d) If the exchange rate is increased from 0.051 HKD / JPY to 0.053 HKD / JPY, is it still more cost-effective to buy in online shop B?

a) Price rate

$= \dfrac{350}{2}$

$= \$175 \text{ / piece}$

b) Price rate

$= \dfrac{10000}{3}$

$\approx ¥3333.33 \text{ / piece}$

c) Chiikawa pouches in online shop B.

3333.33×0.051

$\approx \$170 \text{ / piece}$

∴ local shop A $= \$175 \text{ / piece}$, online shop B $= \$170 \text{ / piece}$

∴ No

d) chiikawa pouches in online shop B

3333.33×0.053

$\approx \$176.67 \text{ / piece}$

∴ No

Students used the exchange rate to calculate the prices in HKD or JPY, then convert to the same currency for comparing prices

Evaluation

▶ Students were interested in collecting the data about the prices of different packages of commodities in the supermarket. Most of the students were able to use the price rates to compare the prices of the commodities.

▶ Students became more familiar with and confident in using mathematical language to express ideas. Their problem solving skills and mathematical knowledge were strengthened.

▶ On task 3, many students compared the prices of pouches by using the same currency and the exchange rate. However, some students cannot distinguish between division or multiplication of exchange rates to find the corresponding currency. It was better to have examples to help students tackling the problems.

▶ Time was limited for most of the S2 groups. Therefore task 4 could not be completed for most of the groups. It was suggested cancelling some parts of the activities.

Learning and teaching strategies
Linear Equations in Two Unknowns - Inquiry-based learning

▶ Glossary, different types of example and assessment rubrics were designed to guide students to explore the criterion of setting simultaneous linear equation in daily life context

Glossary

Sum	Difference
Add/Plus	Minus/ Subtract
Twice/Half	Times
Less than	More than
Years ago	Years Later
Ages/ Price/Number	How old/ How much/How many
Perimeter/Area	Length/width
Percentage	Ratio

Example 1 Shopping problems

The total price of a bread and a carton of milk is $20 whereas the total price of 5 breads and 3 cartons of milk is $84. Find the prices of a bread and a carton of milk respectively.

Example 2 Maths Wording Problems

x and y are two numbers. x is less than twice of y by 3. If the sum of x and y is 15, find the values of x and y.

Example 3 Age Problems

Anna is 32 years younger than her father. 4 years ago, the age of Anna's father was 5 times that of Anna.

Find the present ages of Anna and her father.

Example 4 Geometry Problems

The perimeter of a rectangle is 158 cm. If the length is 7 cm more than 3 times the width, find the length of the rectangle.

Example 5 Percentage Problems

In a fitness centre, there are 210 members. The number of female members is 50% more than the number of male members. Find the difference between the numbers of male members and female members.

Learning and teaching strategies
Linear Equations in Two Unknowns - Inquiry-based learning

► Teachers provided prompts to facilitate peers' feedback.

For example: Are the problems clear/easy to understand/reasonable/creative? Why?

Task 3 Evaluation

Now student B will give marks for the problems student A set. He/ She can refer to the following criteria to evaluate the problems

Criteria	Description	Marks (1-5)
Completeness	**Students can complete the problems** (e.g. observation from teachers)	$Mr.Lam:\ 5$
Clearness and Accuracy	Are the problems clear and easy to understand? (e.g. No grammatical mistakes/ complete sentence)	$Complete\ sentence: 4-5$ $Wrong\ grammer: 2-3$ $Cant\ read =.=: 1$
Reasonable	Are the problems reasonable? Does the answer of the problem make sense? (e.g. Cases such as ages of mother is 10 or -4)	$Reasonable: 4-5$
Creativity	Are the problems creative?	$New\ problem.\ Not\ from\ example$

Student performance

Your Problem

The total price of an orange and a pear is $10. The total price of 4 oranges and 5 pears is $44. Find the prices of an orange and a pear respectively.

Solution

Let $\$x$, and $\$y$ be the prices of an orange and a pear respectively.

$$x + y = 10 \quad \cdots (1)$$
$$4x + 5y = 44 \quad \cdots (2)$$
$$(1) \times 4 : \quad 4x + 4y = 40 \quad \cdots (3)$$
$$(2) - (3) : \quad y = 4$$

Sub $y = 4$ into (1)

$$x + 4 = 10$$
$$x = 6$$

∴ The prices of an orange and a pear is $6 and $4 respectively.

Your Problem

The total price of a rubbish bin and a recycle bag is $23. The total price of 3 rubbish bins and 5 recycle bags is $75. Find the prices of a rubbish bin and a recycle bag respectively.

$[\$20, \$3]$

Set the answer first

Solution

Let $\$x$ and $\$y$ be the prices of a rubbish bin and a recycle bag respectively.

$$\begin{cases} x + y = 23 \quad \cdots (1) \\ 3x + 5y = 75 \quad \cdots (2) \end{cases}$$

From (1). $y = 23 - x \quad \cdots (3)$

$$3x + 5y = 75 \quad \cdots (2)$$
$$3x + 5(23 - x) = 75$$
$$3x + 115 - 5x = 15$$
$$-2x = -40$$
$$x = 20$$

Sub $x = 20$ into (3)

$$y = 23 - 20$$
$$y = 3$$

∴ The prices of a rubbish bin and a recycle bag is $20 and $3 respectively.

Students can set up reasonable application problems with corresponding solutions

Student performance

Your Problems

In a fitness centre, there are __220__ members. The number of male members is 20% more than the number of female members. Find the difference between the numbers of male members and female members.

Solution:

Let x and y be the number of male members and female members respectively.

$$x + y = 220 \quad \dots(1)$$
$$x = y(1 + 20\%) \quad \dots(2)$$

From (2) $x = 1.2y \quad \dots(3)$

Sub (3) into (1):

$$1.2y + y = 220$$
$$2.2y = 220$$
$$y = 100$$

Sub $y = 100$ into (3)

$$x = 1.2(100)$$
$$x = 120$$

∴ the number of male members and female members is 120 and 100 respectively.

Required difference
$$= 120 - 100$$
$$= 20$$

Your Problems

The perimeter of a rectangle is 32 cm. If the length is 1 cm more than 2 times the width, find the length of the rectangle.

Solution:

Let x and y be the width and length of the rectangle respectively.

$$\begin{cases} 2x + 1 = y \dots(1) \\ 2(x + y) = 32 \dots(2) \end{cases}$$

Sub (1) into (2),

$$2[x + (2x + 1)] = 32$$
$$2(x + 2x + 1) = 32$$
$$2(3x + 1) = 32$$
$$6x + 2 = 32$$
$$6x = 30$$
$$x = 5$$

Sub $x = 5$ into (1),

$$2(5) + 1 = y$$
$$y = 10 + 1$$
$$y = 11$$

∴ The length of the rectangle is 11 cm.

Students can set up various application problems in different context.

Student performance

Your Problems

The area of a triangle is 12 cm^2. If twice the base is 2 cm more than the height, find the base and the height of the triangle respectively.

Solution:

Let x cm and y cm be the base and the height of the triangle respectively.

$$2x = y + 2 \quad \text{—①}$$

$$\frac{x \, y}{2} = 12 \quad \text{—②}$$

Sub ① into ②,

$$\frac{x(2x-2)}{2} = 12 \rightarrow \frac{2x^2 - 2x}{2} = 12$$

$$x^2 - x = 12$$

$$x^2 - x = 12$$

$$2x = 24$$

Quadratic equation!!

$$x^2 - x - 12 = 0$$

$$(x+3)(x-4) = 0$$

$$x = -3 \quad \text{or} \quad x = 4$$

(rejected)

$$2(4) = y + 2$$

$$y = 6.$$

∴ The base and height are 4 cm and 6 cm respectively

6

Students may set up some problems which they could not solve (e.g. quadratic equation), teacher will show the steps for extension.

Evaluation

▶ Students were interested in creating their own application problems. They were eager to present their ideas in front of classmates.

▶ Students set up the problems using the technique that they learnt. They generally grasped the strategies for creating completed and reasonable application problems.

▶ More opportunities were provided for students to discuss with each other and present their ideas in mathematical language.

▶ A few students could not manipulate the skills to set up different kinds of problems at the beginning of the activities. More guidance and clearer instructions were needed to help them to set up the problems.

▶ Some students would like to set up area problems in geometry. However, some equations became quadratics as they involved products of unknowns.

Reflection and way forward

▶ Mathematics teachers grasped the strategies for conducting effective lesson planning. However, some resources and materials were obsolete. More organised plan could be formulated with timely monitoring to reduce the workload of subject teachers.

▶ Observable changes in students encouraged teachers to develop a more adaptable and responsive curriculum and lessons in the following years. Also, this provides an opportunity to develop structured lesson study and create a positive learning environment that initiates teachers to share their ideas and cooperate with one another.

▶ Topics such as percentage and linear equations in one unknown in S1 level are good examples to adopt the inquiry-based learning. Mathematics teachers could make good use of the experience gained to develop more intriguing investigation activities for different forms in the future.

End