Developing Statistical Teaching Material through Statistical Literacy

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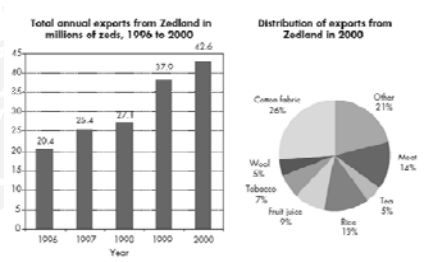
Outline

- Aims of Statistics Education
  - Through PISA problems as a clue
- Revised Japanese Curriculum Related to Statistics
- Hierarchy of Statistical Literacy
  - As a guideline to develop teaching materials
- Some examples of Statistical tasks
- Lesson example of Statistics from Japan

2

PISA Problems ①

The graphics below show information about exports from Zedland, a country that uses zeds as its currency.



QUESTION 13.1

What was the total value (in millions of zeds) of exports from Zedland in 1998?

Answer: .....

QUESTION 13.2

What was the value of fruit juice exported from Zedland in 2000?

A. 1.8 million zeds.
B. 2.5 million zeds.
C. 2.4 million zeds.
D. 3.4 million zeds.
E. 5.8 million zeds.

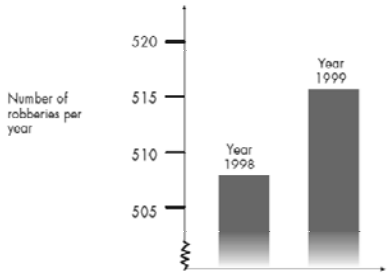
Basic Reading Task

3

PISA Problems ②

A TV reporter showed this graph and said:

"The graph shows that there is a huge increase in the number of robberies from 1998 to 1999."



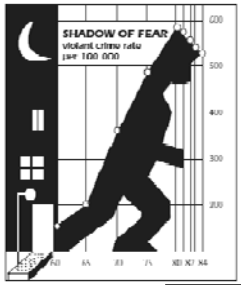
Critical Task

Do you consider the reporter's statement to be a reasonable interpretation of the graph? Give an explanation to support your answer.

4

PISA Problems ③-1

The following graph was taken from the weekly Zealand *News Magazine*.



Basic Reading Task

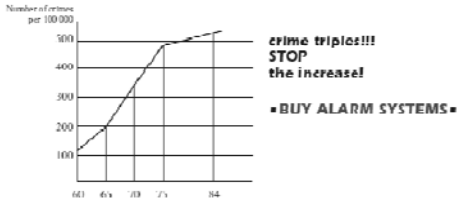
It shows the number of reported crimes per 100 000 inhabitants, starting with five-year intervals, then changing to one-year intervals.

How many reported crimes per 100 000 were there in 1960?

5

PISA Problems ③-2

Manufacturers of alarm systems used the same data to produce the following graph:



How did the designers come up with this graph and why?

Critical Task

The police were not too happy with the graph from the alarm systems manufacturers because the police want to show how successful crime fighting has been.

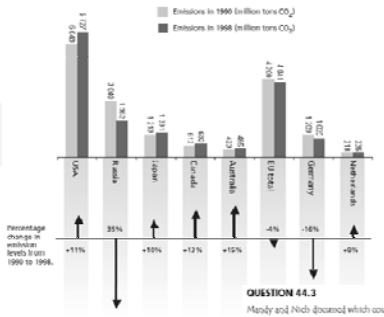
Design a graph to be used by the police to demonstrate that crime has decreased recently.

6

PISA Problems ④

Many scientists fear that the increasing level of CO_2 gas in our atmosphere is causing climate change.

The diagram below shows the CO_2 emission levels in 1990 (the light bars) for several countries (or regions), the emission levels in 1998 (the dark bars), and the percentage change in emission levels between 1990 and 1998 (the arrows with percentages).



Description Task

QUESTION 44.3

Mandy and Nick discussed which country (or region) had the largest increase of CO_2 emissions. Each came up with a different conclusion based on the diagram.

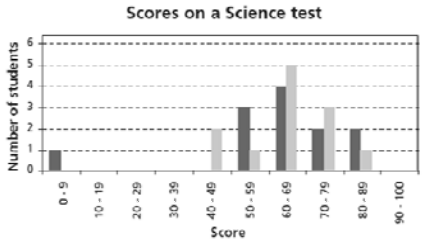
Give two possible 'correct' answers to this question, and explain how you can obtain each of these answers.

7

PISA Problems ⑤

The diagram below shows the results on a Science test for two groups, labelled as Group A and Group B.

The mean score for Group A is 62.0 and the mean for Group B is 64.5. Students pass this test when their score is 50 or above.



Description Task

Looking at the diagram, the teacher claims that Group B did better than Group A in this test.

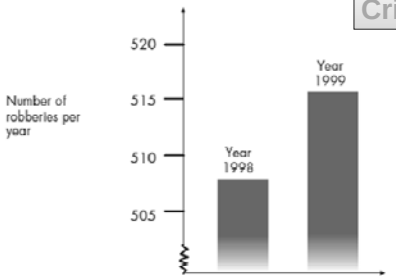
The students in Group A don't agree with their teacher. They try to convince the teacher that Group B may not necessarily have done better.

Give one mathematical argument, using the graph, that the students in Group A could use.

8

One of Japanese Result of PISA Problems

Critical Task



PISA2003

	Perfect answer	Partial answer	mistake	Blank
Japan	11.4%	35.4%	38.8%	14.4%
OECD average	15.4%	28.1%	41.5%	15.0%

9

Content strands in primary school

Course of Study 1999
(same as National Curriculum)

	Number and calculation	Quantity and measurement	Space and shape	Quantity Related
Y1(3.4*)	○	○	○	
Y2(4.4)	○	○	○	
Y3(4.3)	○	○	○	○
Y4(4.3)	○	○	○	○
Y5(4.3)	○	○	○	○
Y6(4.3)	○	○	○	○

Course of Study 2008

	Number and calculation	Quantity and measurement	Space and shape	Quantity Related
Y1(4)	○	○	○	○
Y2(5)	○	○	○	○
Y3(5)	○	○	○	○
Y4(5)	○	○	○	○
Y5(5)	○	○	○	○
Y6(5)	○	○	○	○

10

*Note: Average hours per a week for Math.

Content strands in lower secondary school

Course of Study 1999
(same as National Curriculum)

- Number and expression
- Space and shape
- Relation of quantities

Course of Study 2008

- Number and expression
- Space and shape
- Function
- Using and applying data

Y7:3period,Y8:3period,Y9:3period per a week(A period is 50 minutes)

Y7:4period,Y8:3period,Y9:4period per a week(A period is 50 minutes)

11

Content strands in higher secondary school

grade10(16years old): Math Ⅰ is compulsory subject

Course of Study 2000

- Equation and inequality
- Quadratic Function
- Figure and measurement

Course of Study 2009

- Number and expression
- Figure and measurement
- Quadratic Function
- Analysis of data

12

Contents of Statistics on National Curriculum in JAPAN primary(Y1-Y6) and lower secondary(Y7-Y9) school

Contents \ Curriculum revised year	1989	1999	2008
Representation using picture and chart			Y1
Simple table and graph	Y2	Y3	Y2
Bar graph	Y3	Y3	Y3
Line graph	Y4	Y4	Y4
Pi graph	Y5	Y5	Y5
Column graph	Y5	Y5	Y5
Average	Y5(Average of measurement)	Y6	Y6
Frequency table	Y6		Y6
Possible outcome	Y6	Y8	Y6
Frequency table, Histogram	Y8		Y7
Mean, Median, Mode	Y8(Mean only)		Y7
Range	Y8		Y7
Relative frequency	Y8		Y7
Approximation	Y8		Y7
Probability	Y9	Y8	Y8
Sampling and population	Y9		Y9

Aim of each grade's "Using and Applying of Data"

Y7	**Along with the purpose, collect data, organize data by using ICT and interpret those**
Y8	**Through the investigation of uncertain events, understand probability itself and how to use probability**
Y9	**Foster the ability to read the tendency of population from sample**

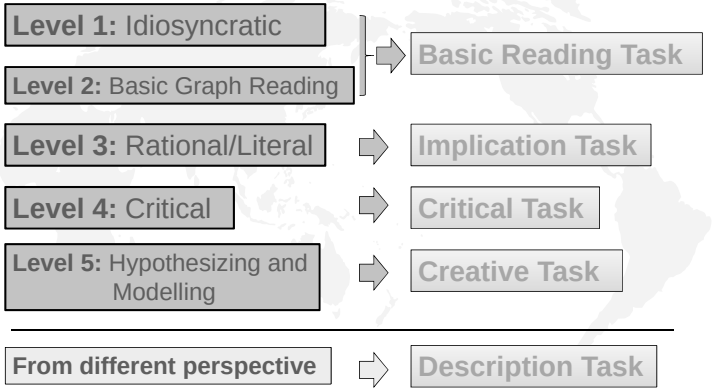
14

Hierarchy of Statistical Literacy

- Level 1: Idiosyncratic
  - Students at this level cannot read values or trends in graphs. They fail to connect some features extracted from graphs with context.
- Level 2: Basic Graph Reading
  - Students at this level can read values and trends in graphs. But they cannot explain contextual meanings of trends or features, which they could see, and can't contextualize events presented.
- Level 3: Rational/Literal
  - Students at this level can read values and trends. They explain contextual meanings literally in terms of features shown in a graph. They cannot suggest any alternative interpretations but use only presented meanings.
- Level 4: Critical
  - Students at this level can read graphs and understand presented contextual meanings. Still more, they can evaluate the reliability of presented contextual meaning. They can question information presented.
- Level 5: Hypothesizing and Modelling
  - Students at this level can read graphs, and accept and evaluate some presented information. They can form their own explanatory hypotheses or models.

Aoyama K. (2007). Investigating a hierarchy of students' interpretations of graphs, *International Electronic Journal of Mathematics Education, vol. 2, No. 3*, pp.298-318.

Apply the Hierarchy as a Guideline



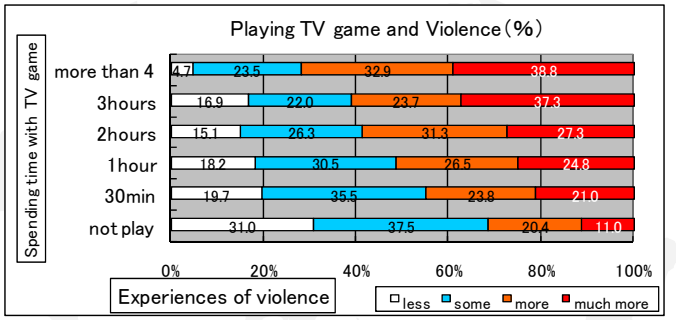
16

Example of Task① Global Data in 2008

Country	Amount of CO2 emission (million ton)	Population (million)	GDP (billion US$)
Japan	1,151.1	127.8	4,879.84
Korea	501.3	231.6	931.41
China	6,508.2	1,328.6	4,519.95
United States	5,595.9	305.8	14,291.55
Canada	550.9	32.9	1,502.68
UK	510.6	60.8	2,182.43
Italia	430.1	58.9	2,307.30
Netherland	177.9	16.4	875.27
Spain	317.6	44.3	1,601.41
German	803.9	82.6	3,640.73
France	368.2	61.6	2,842.52
Australia	397.5	20.7	1,061.04

- Is Japan “a bad country for environment”, because the amount of CO2 emission of Japan is ranked third?

Examples of Task②



- Can you conclude “Spending more time playing TV game make children more violent”?

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18

Lesson Example from Japan related to “Description Task”

- The table right shows running time (in hours) of batteries from two companies.
- The table below shows summary statistics of those.
- Can you choose which company’s battery is better to use.

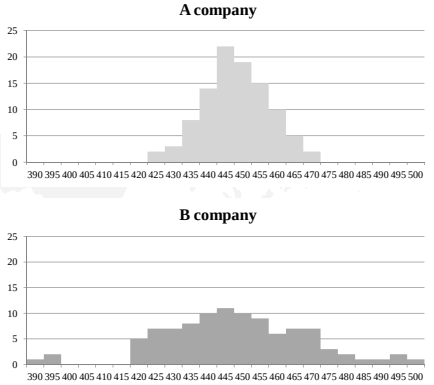
	A company	B company
Number	100	100
Average	448.1	447.9
Median	448	447
Mode	445	445
Min	423	391
Max	472	501
Range	49	110

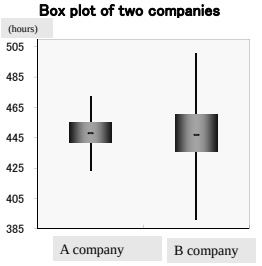
(unit：hours)

A company				B company			
423	442	448	455	391	436	447	462
424	443	448	455	394	436	448	463
428	443	448	456	396	437	448	463
429	444	448	456	418	437	448	464
429	444	448	456	420	437	449	464
433	444	449	456	421	438	449	464
434	445	449	457	422	438	450	465
435	445	449	457	422	439	450	465
435	445	449	458	425	440	450	468
436	445	449	458	425	440	451	468
436	445	450	459	426	440	452	468
437	445	450	459	426	441	453	469
437	445	450	459	427	441	453	470
438	445	450	460	427	442	454	470
438	445	450	460	427	442	454	471
439	445	451	461	429	444	455	474
440	445	451	461	430	445	455	475
440	445	452	463	430	445	455	475
440	446	453	464	432	445	456	478
441	446	453	465	432	445	457	479
441	447	454	465	432	445	458	484
441	447	454	466	432	445	459	488
441	447	455	467	435	446	459	493
442	447	455	470	435	446	459	494
442	448	455	472	435	447	460	501

19

Lesson Example from Japan related to “Description Task”





20