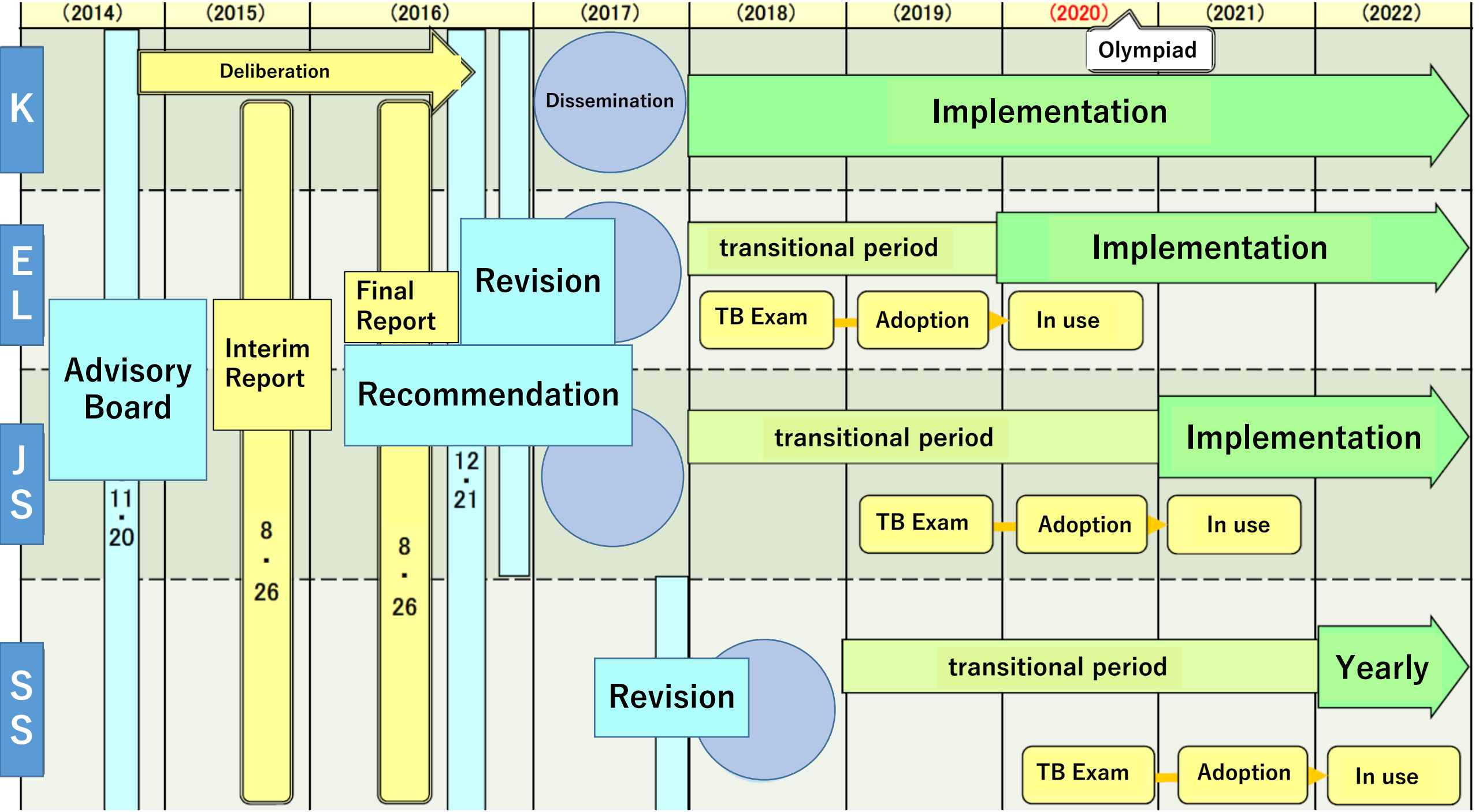
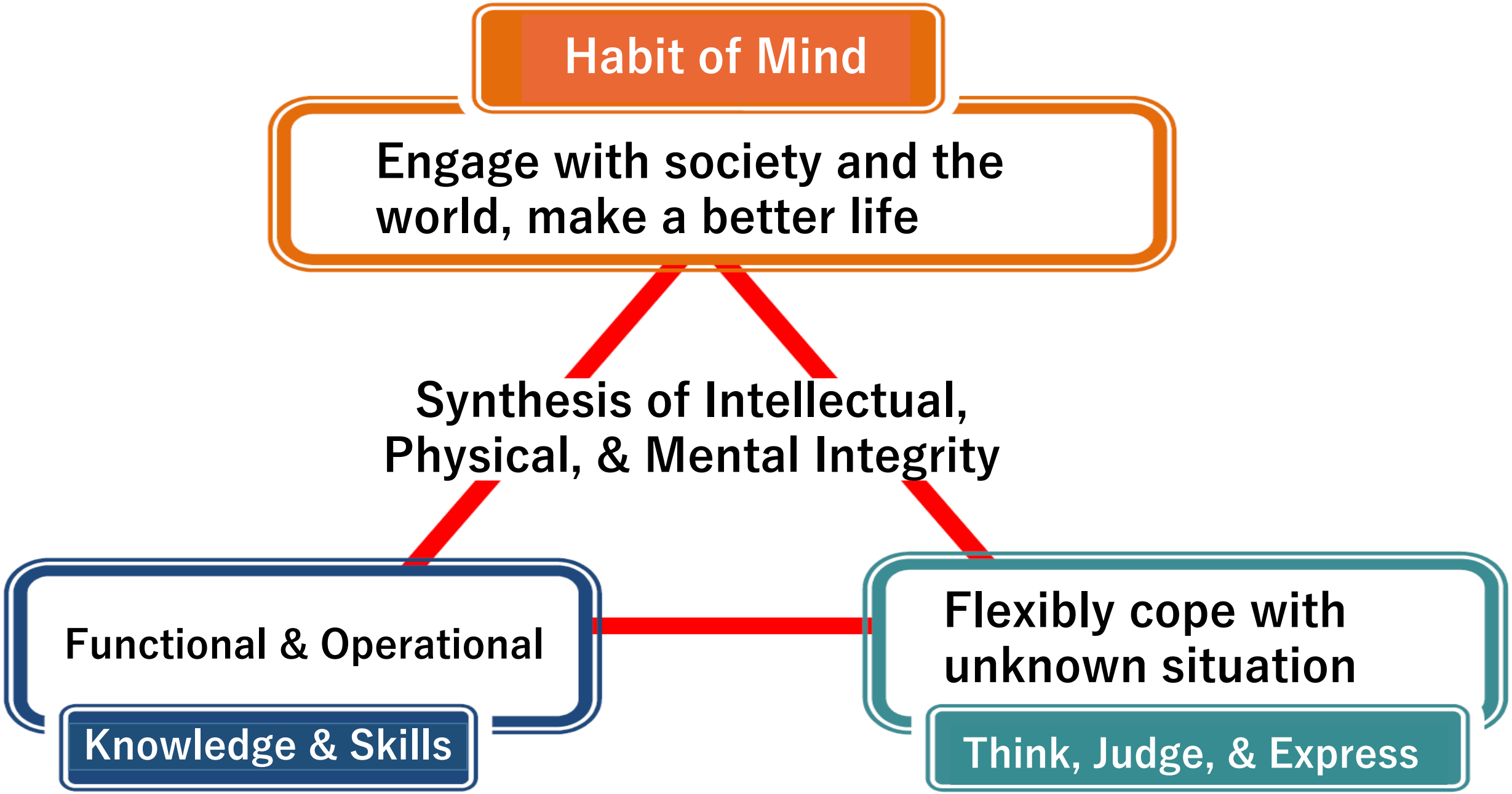
13th APEC-Khon Kaen International Symposium:
8-11, September, 2018, Khon Kaen University, Thailand

New National Mathematics Curriculum in Japan: with Special Attention to Statistics

Minoru OTANI
Kanazawa University, Japan
mohtani@ed.kanazawa-u.ac.jp


(2014)
(2015)
(2016)
(2017)
(2018)
(2019)
(2020)
(2021)
(2022)
Olympiad
K
E
L
J
S
S
S
Deliberation
Dissemination
Implementation
Advisory Board
Interim Report
Final Report
Revision
Recommendation
transitional period
Implementation
TB Exam
Adoption
In use
11 ▪ 20
8 ▪ 26
8 ▪ 26
12 ▪ 21
transitional period
Implementation
TB Exam
Adoption
In use
Revision
transitional period
Yearly
TB Exam
Adoption
In use

Competency Based Curriculum: Three Pillars



Objective: Junior Secondary

- To develop mathematical thinking while engaging in mathematical activity and exerting mathematical ideas. We aim to cultivate the following competency.
-
  (1) Understand fundamental concepts, principles, laws on quantities and figures. Acquire skills of mathematize situations, interpret results, express and process mathematically.
- (2) Ability to consider events logically, find patterns in quantities and figures and generalize and extend them, express events concisely, clearly and appropriately using mathematical expressions.
- (3) Cultivate attitudes to enjoy mathematical activities, appreciate mathematics, persistently think and utilize mathematics to life and learning, reflect on the process of problem solving so as to evaluate and improve it.

Class Hours

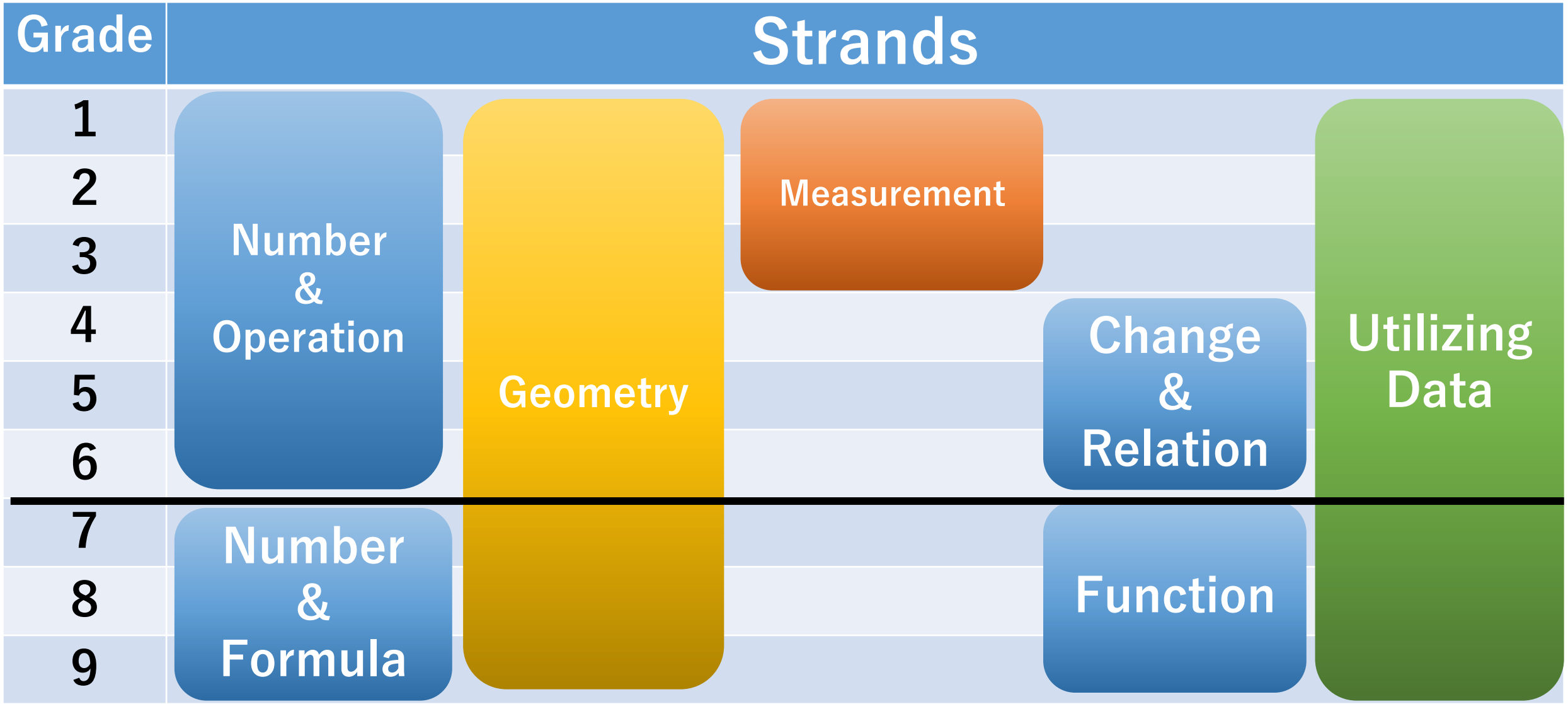
Elementary Mathematics

Grade	Class Hours/Week
1	4 (45 min.)
2	5
3	5
4	5
5	5
6	5

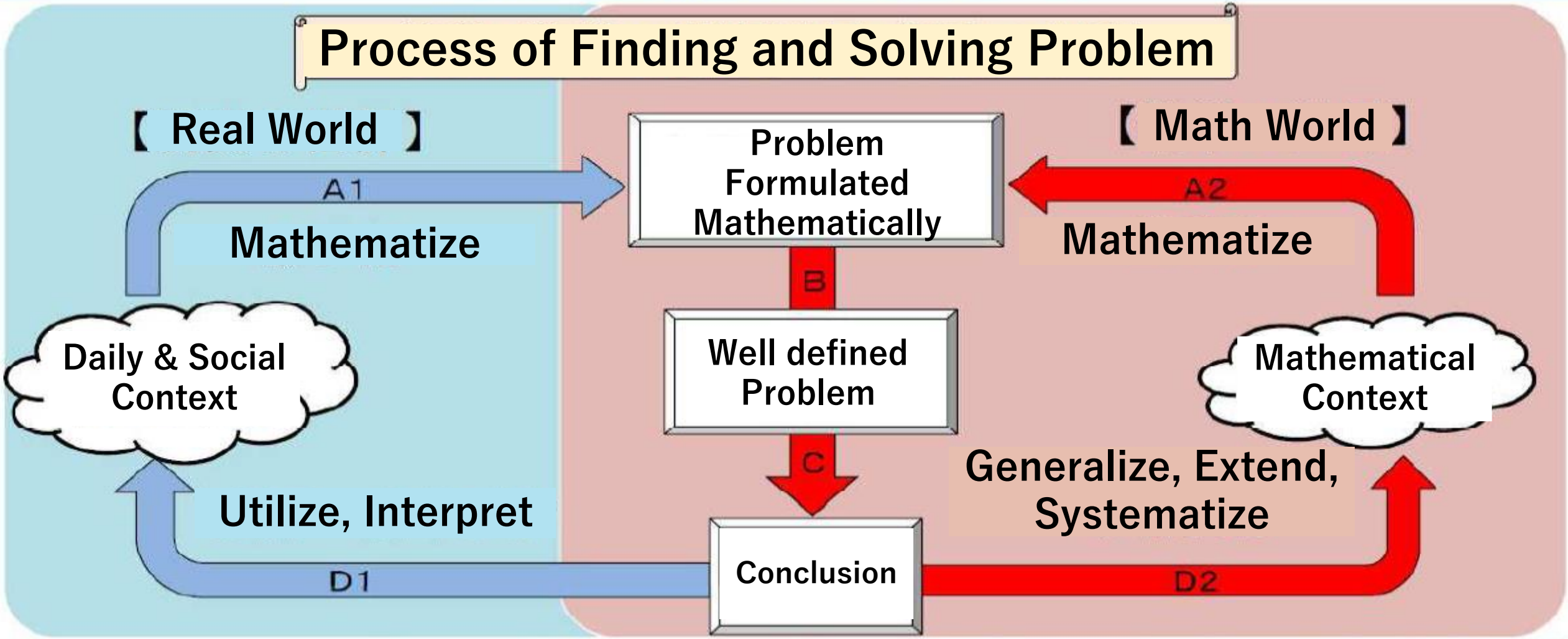
Secondary Mathematics

Grade	Class Hours/Week
7	4 (50 min.)
8	3
9	4
10-12	I 3, A 2 II 4, B 2 III 3, C 2
10-12	Mathematical Science Basic 1, Inquiry 2~5

Content


Grade
Strands
1
2
3
4
5
6
7
8
9
Number & Operation
Geometry
Measurement
Change & Relation
Utilizing Data
Number & Formula
Function

A Model of Learning Process in Mathematics



Formulate mathematical problem from daily and social context, process and solve it.

Generalize and extend mathematical results so as to solve problem.

Formulate situation mathematically, find mathematical problem, and solve it independently or collaboratively.

Zooming in

A1: Formulate mathematical problem from daily and social context, process and solve it.

・Ability to find mathematical problems focusing on the quantity embedded in context.

・ Ability to capture the characteristics of events and express them using mathematical representations. Ability to mathematize reality.

Process of Finding and Solving Problem

Query | P P | D A | C → Q＋PPDAC

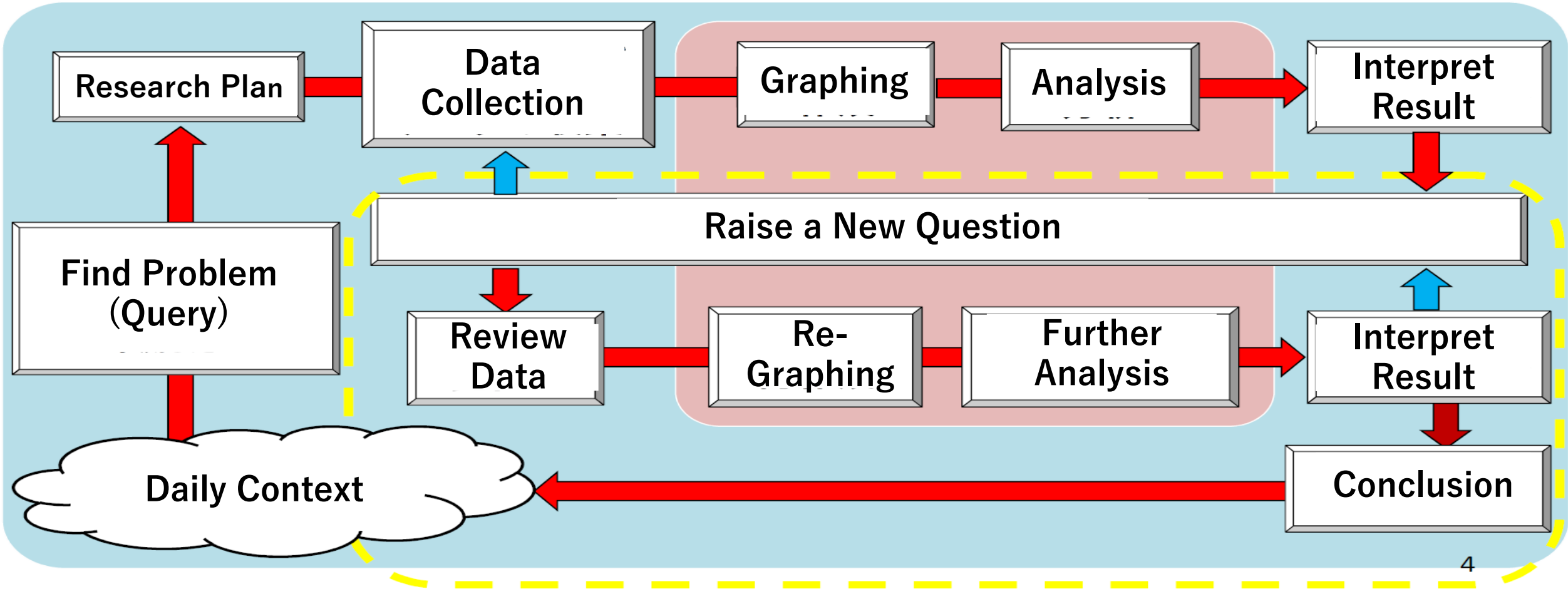
次の問題解決へ

Not a uniflow steps

算数・数学の内容を深める

Formulate mathematical problem from daily and social contexts, process and solve.

Concerning daily context, collect data, make graphs, and analyze them repeatedly so as to make judgement.

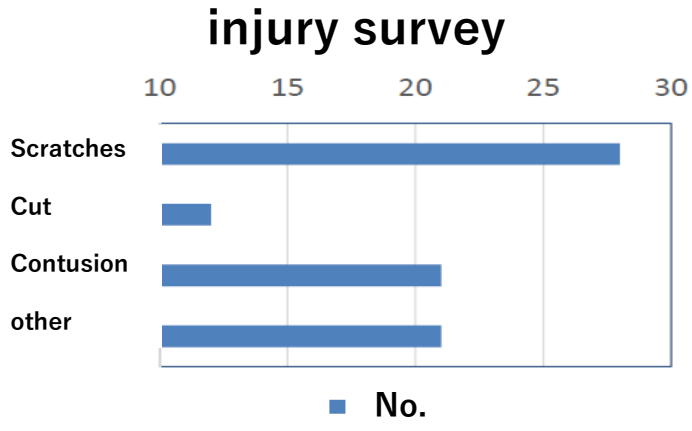


Grade 3 Bar Graph

Reflect critically on conclusion drawn by statistical method

Query:
What kind of injury is common?

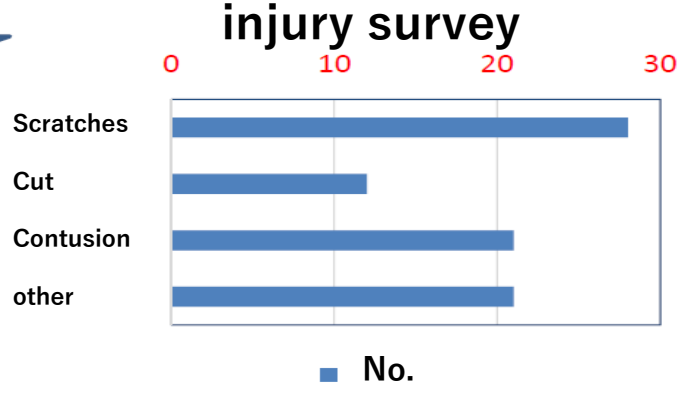
Injury	No.
scratches	28
cut	12
contusion	21
other	21
Total	82



Analysis:
many scratches, very few cuts.

As the scale does not start from 0, it seems that there are few cuts

In bar graphs, misunderstandings may arise if you do not start the scale from 0.

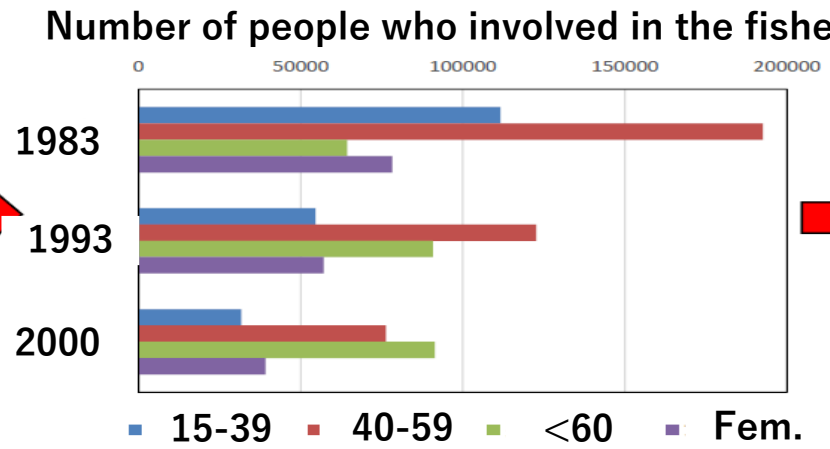


Analysis:
many scratches, cuts are not so small.

Grade 5 Bar Chart

Concerning daily context, collect data, make graphs, and analyze them repeatedly so as to make judgement.

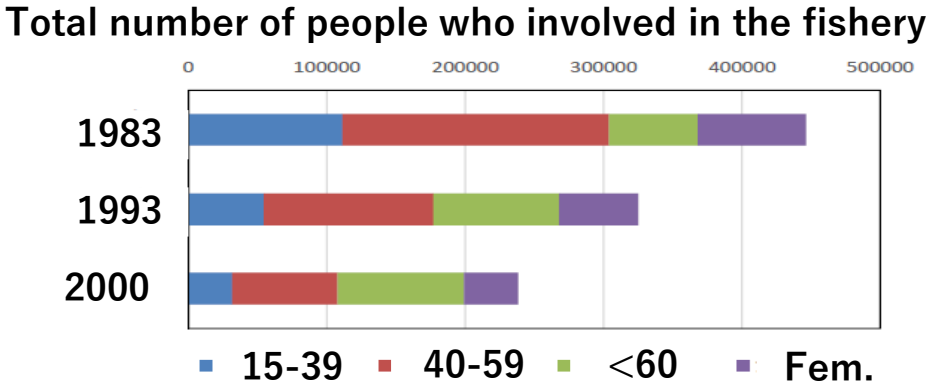
Query:
How has the age group of those involved in the fishery changed?

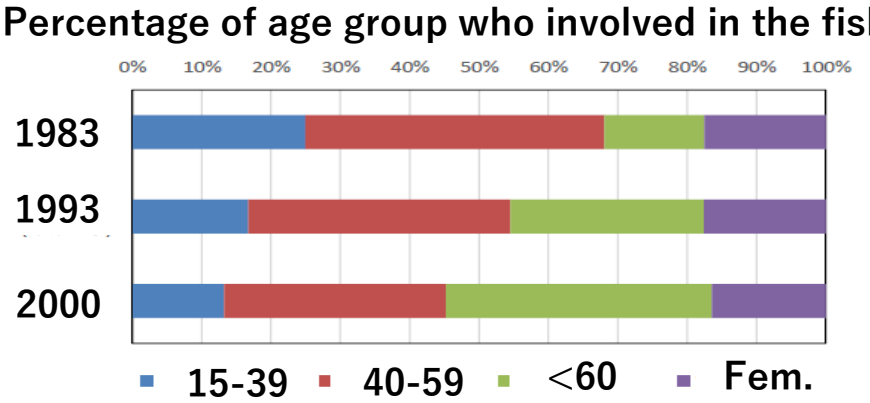


Analysis:
Age group of 40-59 was the most frequent in 1983, but over 60 was the most frequent in 2000.

New Query:
How has the total number changed?
How has the percentage by group changed?

Utilize ICT





Grade 8 Distribution Trends

Organize the data according to the purpose, grasp the distribution trends, make decisions.

Query:
Which player is likely to fly further in the next jump?

Mr. Harada (m)

117.0	108.5	102.0
119.5	113.0	66.0
120.0	114.0	120.0
126.0	122.0	136.0
89.5	113.0	79.5
117.5	108.0	137.0
123.5	107.0	

Average 112.0m

Mr. Funaki (m)

111.0	116.0	121.5
113.5	117.0	122.5
119.0	119.0	126.0
121.0	116.0	132.5
109.5	108.5	118.5
108.0	113.0	125.0
116.5	120.0	

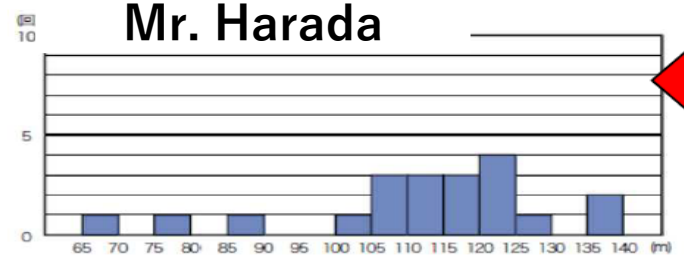
Average 117.7m

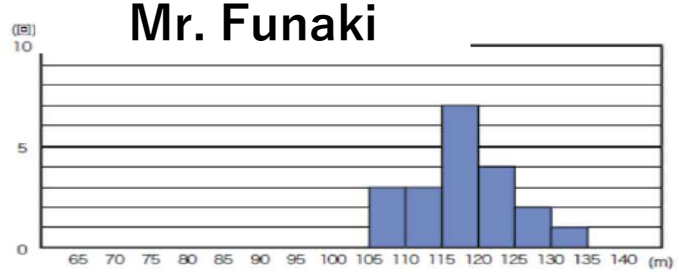
An interpretation:
If you decide on average value, you can choose Mr. Funaki.

Utilize ICT

New Query:
Mr. Harada recorded the longest 137 m. How is the trend of the overall distribution?

Graphing





Interpret

Judgements

Daily Context

・Mr. Harada took over 130 meter twice and Mr. Funaki did once, so I will choose Mr. Harada.
・Mr. Funaki had a smaller range and a larger minimum, so I will choose Mr. Funaki.

Grade 8 Engaging with Statistical Process

Organize the data according to the purpose, grasp the distribution trends, make decisions.

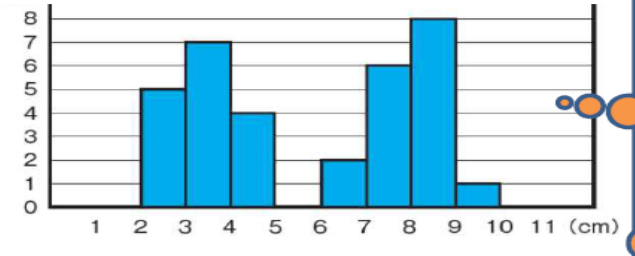
Query:
What are the features of the rectangular shape that people feel beautiful?

Survey
Please write a rectangle you feel beautiful.

Data: length of the other side

8.0	8.0	7.0	6.5	2.4	4.1	3.4
3.1	6.0	2.8	2.4	4.0	3.0	3.2
7.5	8.0	7.5	9.0	3.0	8.2	8.5
4.0	3.6	8.1	7.1	8.1	3.4	
2.8	2.5	7.0	8.1	7.1	4.1	

Graph and Distribution



Interpret:
There are double peak in the distribution.

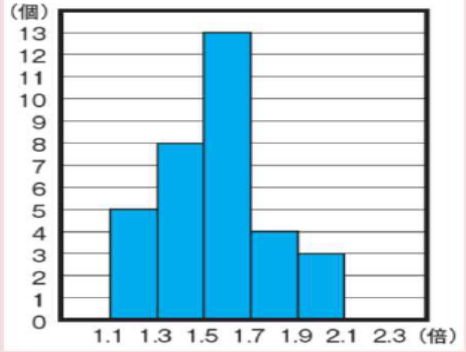
Utilize ICT

New Query:
These are two kinds of allocation and if we align the ratio of lengths, we may find some features.

Revision

Re-graphing

New Distribution

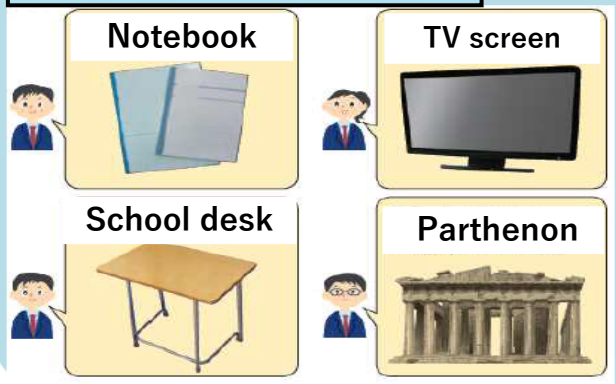


Conclusion

Mode of the ratio of two sides of beautiful rectangular shapes lies in range 1.5-1,7.

Beautiful rectangular shapes in familiar situations.

Daily Context



Grade 8 Index for Grasping Distribution

Organize the data according to the purpose, grasp the distribution trends, make decisions.

Problem

There were two math tests, and the average score of the class was 60 points. A student scored 70 points. That student worked hard for the second test, but the score was also 70 points, the score of the class was 60 points. The scores of the two tests are shown in the following table. This student is disappointed with the result of the second round. Can I think that the students' performance is the same by two tests?

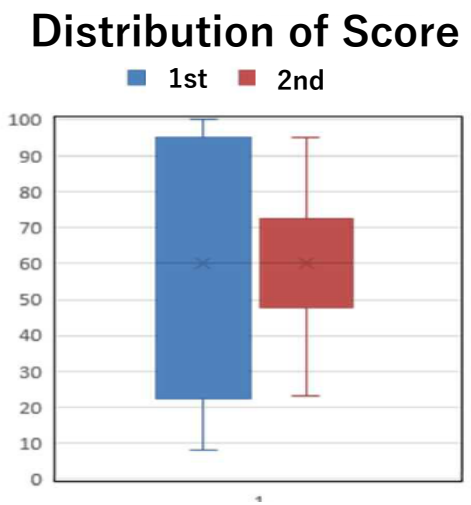
Since the points and average are the same, it is same.

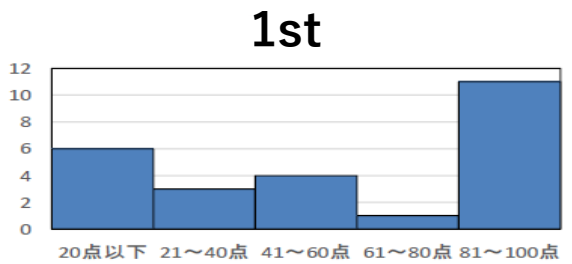
Student's ranking is going up?

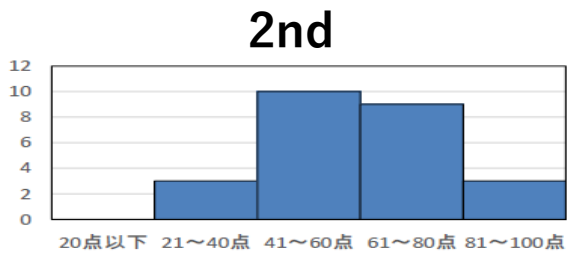
How about other students?

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1st	11	31	88	96	100	97	25	16	8	42	54	94	99	99	70	48	13	60	89	93	100	20	18	38	91
2nd	42	53	62	82	95	73	47	41	23	50	58	72	80	76	70	55	40	61	63	60	92	49	38	52	66

Utilize ICT







Looking at histograms and box whiskers, the distribution of scores is different.

Are there indices that can grasp the distribution of the score of the students well?

Deviation

No.	1	2	3	4	5	・・・
1st	-49	-29	28	36	40	・・・
2nd	-18	-7	2	22	35	・・・

Absolute Value

No.	1	2	3	4	5	・・・
1st	49	29	28	36	40	・・・
2nd	18	7	2	22	35	・・・

The average deviation is always 0, so it will not be an index.

Although the average of the absolute values of the deviations can be used as an index, the process is troublesome.

Average of squared deviation

No.	1	2	3	4	5	・・・
1st	2401	841	784	1296	1600	・・・
2nd	324	49	4	484	1225	・・・

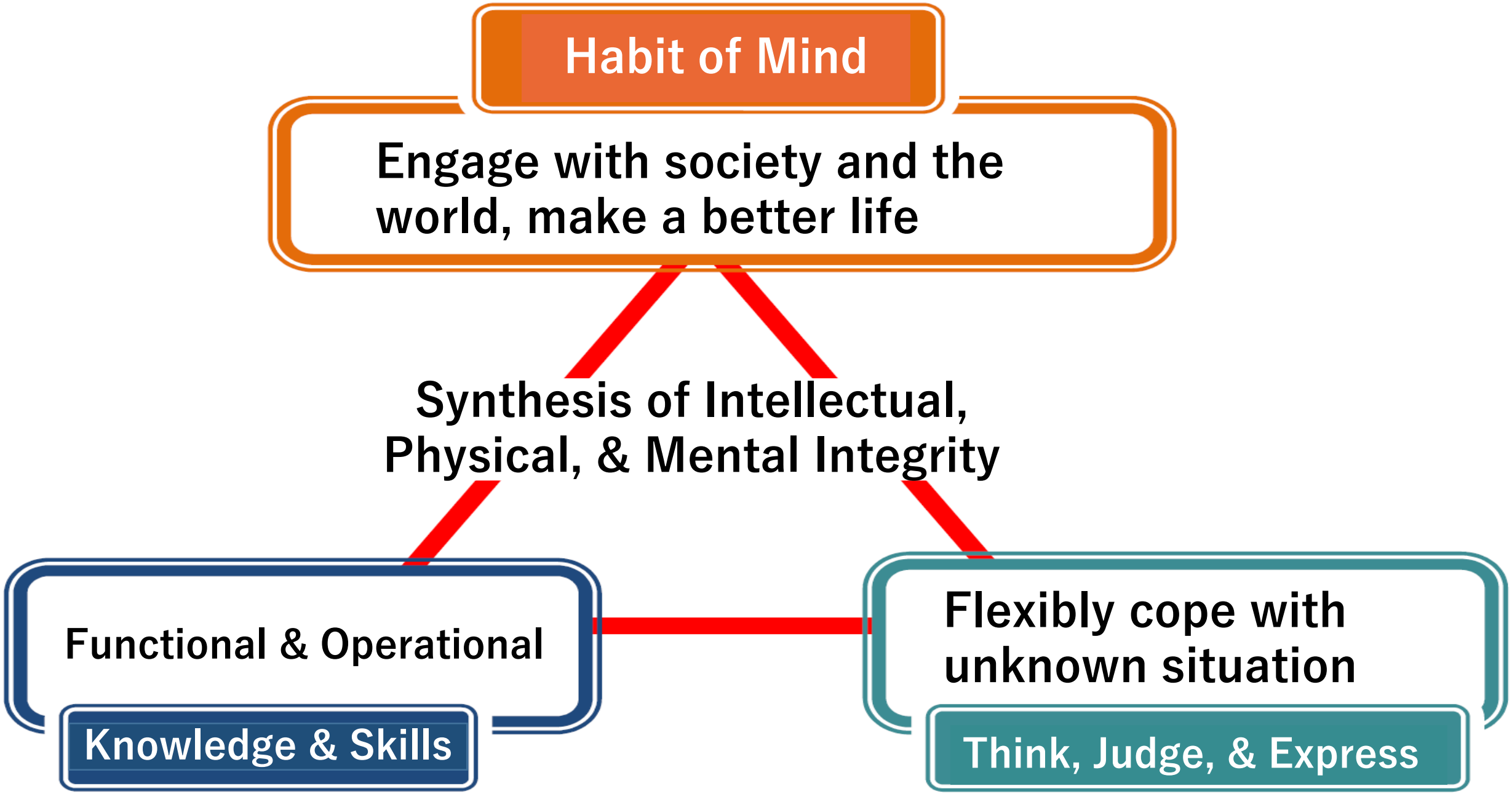
The average of squared deviation is possible representing the magnitude of the distribution of data.

In order to match the dimension with the original data, take a positive square root.

$$\sigma = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \cdots + (x_n - \bar{x})^2}{n}}$$

$* [\bar{x} - \sigma, \bar{x} + \sigma]$, $[\bar{x} - 2\sigma, \bar{x} + 2\sigma]$, $[\bar{x} - 3\sigma, \bar{x} + 3\sigma]$ check if how much data is covered in each range.

Competency Based Curriculum: Three Pillars



Content: Utilizing Data (Grade 8)

- Concerning distribution of data, instruct with mathematical activity the following matters to be acquired.
- (1) Knowledge and skills.
- Understand the necessity and meaning of histogram and relative frequency.
- Organize data into tables or graphs by using ICT.

- (2) Ability to think, judge, and express.
- Collect and analyze data according to purpose, read the distribution tendency of the data, critically consider and judge.

Content: Utilizing Data (Grade 8), Cont.

- Concerning likelihood of uncertain events, we instruct with mathematical activity, the following matters to be acquired.
- (1) Knowledge and skills.
- Understand the necessity and meaning of the probability obtained by numerous observations and many trials.
- (2)Ability to think, judge, and express.
  ・Read and express the likelihood of uncertain events based on the results of numerous observations and many trials.

- Technical terms: Range, Cumulative frequency.

Simplified Content Overview

Grade	Topics
1	Picturing Quantity
2	Dot plot
3	Table, Bar graph
4	Two dimensional table, Line graph
5	Pie chart, Band graph, Mean
6	Representative value (average, median, mode), Graphing frequency distribution, Number of cases
7	Histogram, Relative frequency, Empirical probability
8	Quartile range, Box-whisker plot, Mathematical probability
9	Sampling

Simplified Content Overview

Course	Topics
Math I	Variance, Standard deviation, Scatter plot, Correlation coefficient
Math A	Permutation, Combination, Expected value, Independent trial Conditional probability,
Math B	Sampling survey method, Random variable, Probability distribution, Binomial distribution, Normal distribution, Interval estimation, Hypothesis test

Statistical Inference (Math B)

- Concerning statistical inference, instruct with mathematical activity the following matters to be acquired with recognition of the usefulness.
- (1) Knowledge and skills.
- Deepen Understanding of the necessity and meaning of histogram and relative frequency.
- Deepen understanding of the idea of sample survey.
- Understand random variable and probability distribution.
- Understand the nature and characteristics of binomial distribution and normal distribution.
- Understand the method of interval estimation and hypothesis test using normal distribution.

Statistical Inference (Math B)

- (2) Ability to think, judge, and express.
- Examine the probability distribution and the characteristics of the sample distribution using the mean, variance, standard deviation of the random variables.
- Design investigation in accordance to the purpose, processing by using ICT, estimate and judge the features and trends of the population based on the collected data, use the method of sample survey, and critically consider the results.

- Technical Terms: Confidence Interval, Significance level

Thank you for your attention!

mohtani@ed.kanazawa-u.ac.jp