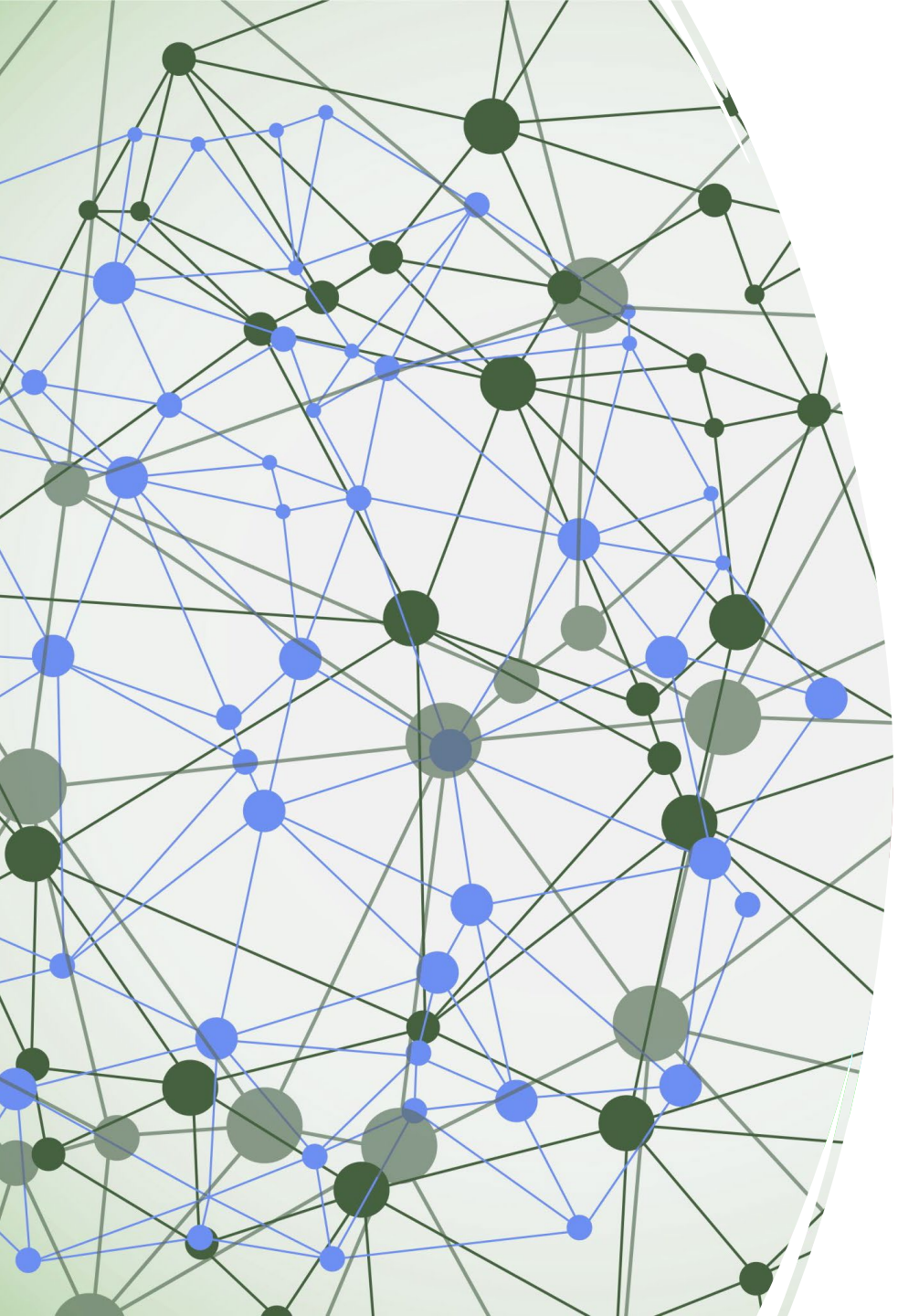


The Current State of Mathematical Literacy Development in Japanese Mathematics Education

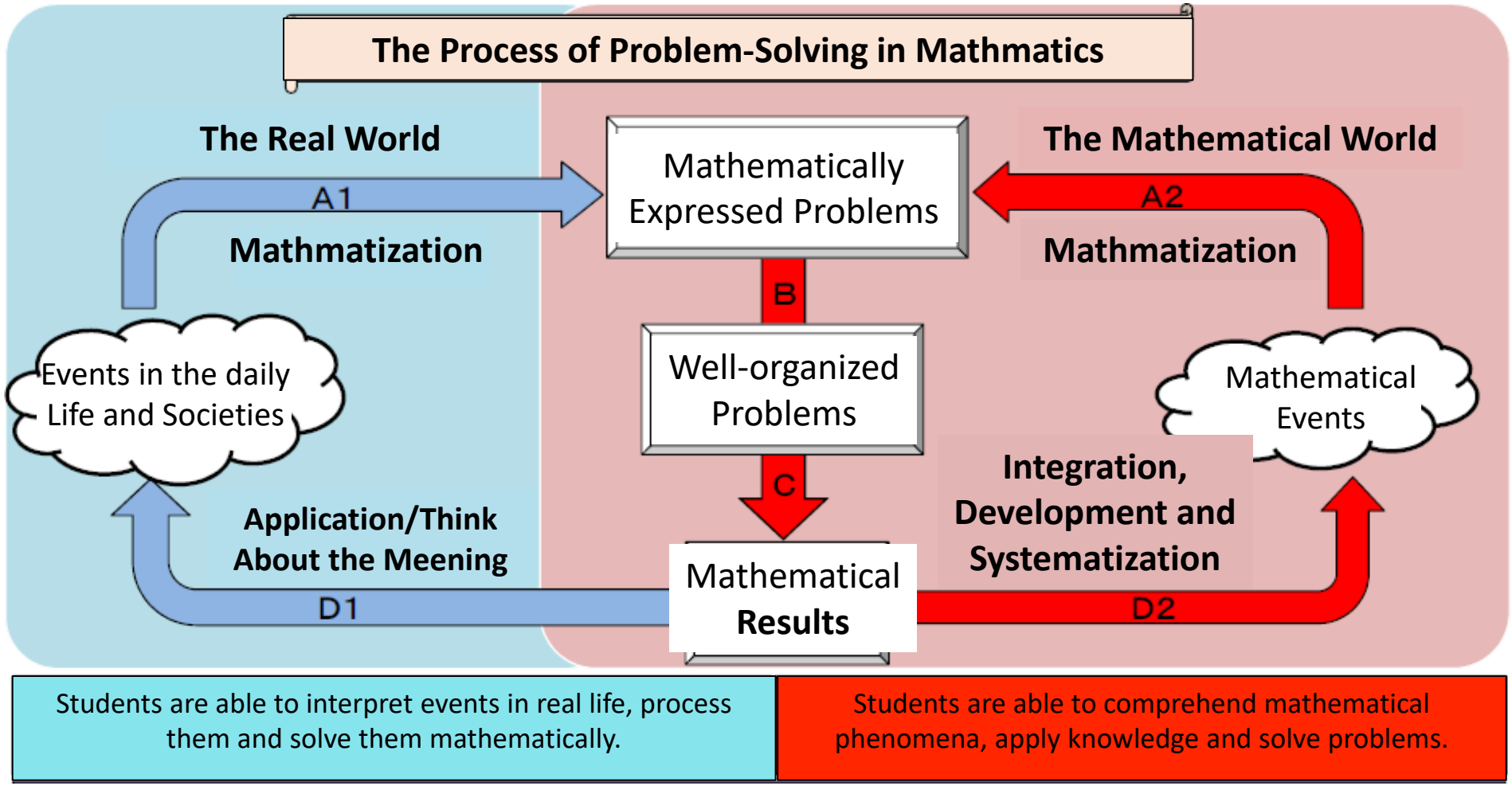
Prof. Keiichi Nishimura

Tokyo Gakugei University
Research Organization for Next-Generation Education
Project for Inquiry-based Learning in High Schools

Mathematical literacy

Mathematical literacy is an individual's capacity to reason mathematically and to **formulate, employ, and interpret mathematics** to solve problems in a variety of real-world contexts. It includes concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to know the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective 21st century citizens.

Current National Curriculum Standards



Enhanced Learning About Statistics

Elementary School

A Numbers and Calculation
B Geometric Figures
C Measurement (1st–3rd Grade)
Change and Relationships (4th-6th Grade)
D Use of Data
Mathematical Activities

Junior High School

A Numbers and Algebraic Expressions
B Geometric Figures
C Function
D Making Use of Data
Mathematical Activities

1st Year: Data Distribution Trends
2nd Year: Data Distribution Comparison
3rd Year: Sampling Surveys

High School

Mathematics I Data Analysis

Data Distribution
• Variance and Standard Deviation
Data Correlation
• Scattergrams, Correlation Coefficient
Hypothesis Testing

Mathematics B Statistical Inference

• Population and Sampling
• Statistical Inference
*Interval Estimation, Hypothesis Testing

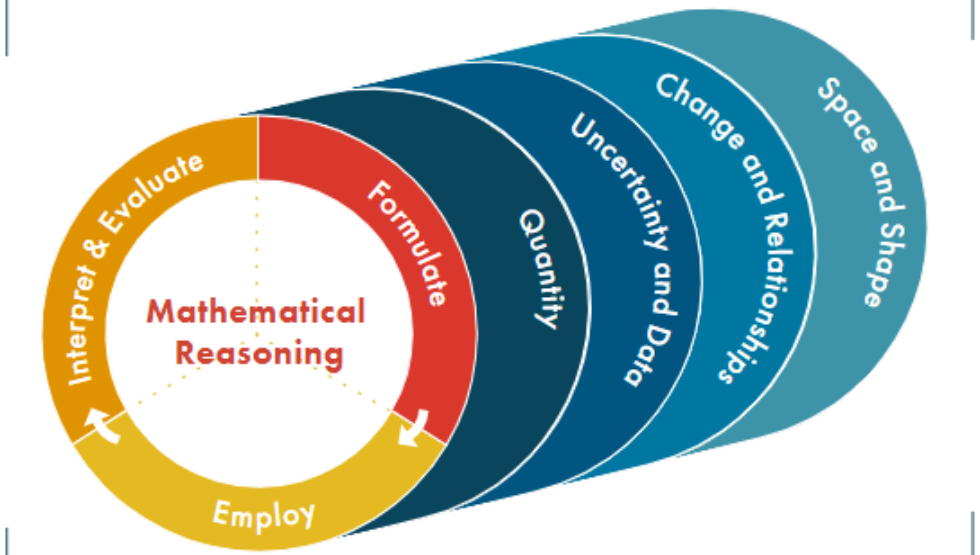
Mathematical literacy

Mathematical literacy is an individual's capacity to reason mathematically and to formulate, employ, and interpret mathematics to solve problems in a variety of real-world contexts. It includes concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to know the role that mathematics plays in the world and to make the well-founded judgments and decisions **needed by constructive, engaged and reflective 21st century citizens**.

PISA 2022 Assessment Framework (2021)

Contexts

- Personal
- Occupational
- Societal
- Scientific



21st Century Skills

- Critical Thinking
- Creativity
- Research & Inquiry
- Self-direction, Initiative, and persistence
- Information Use
- Systems Thinking
- Communication
- Reflection

Challenge in a Real World Context

Contexts

- Personal
- Occupational
- Societal
- Scientific

Mathematical Literacy

What is Mathematical Literacy for Our Society?

FY2015 National Assessment of Academic Ability

Junior High School Mathematics B

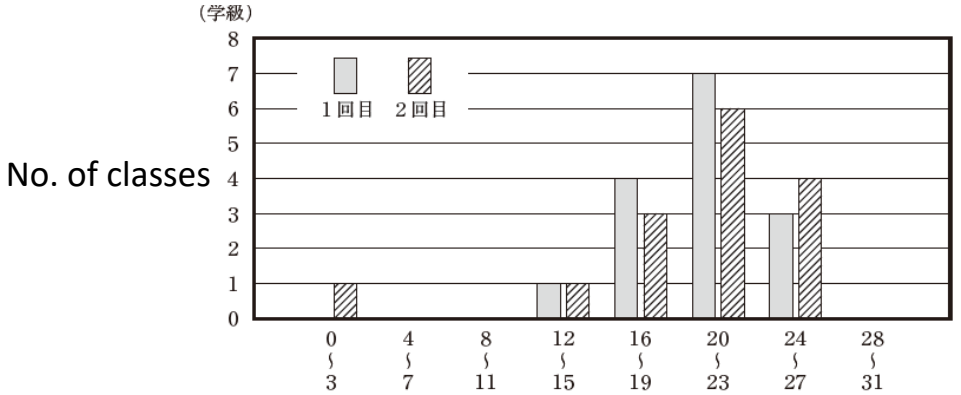
5. The School Service Committee decided to perform a Lost and Found Survey with all 15 classes to raise awareness about lost property.

They ran the survey twice for the same number of days. The results are shown in the table and the graph. Yuka made the graph, which tells us, for example, that there was a class that found 12 to 15 items respectively in the surveys.

Takuya made the table shown below.

		1st Survey	2nd Survey
Type	Stationery	201	212
	Handkerchief, towel	49	28
	Other	55	50
Total number of items found		305	290
Average number of items found per class		20.3	19.3

The graph made by Yuka.



2. Yuka and Takuya are talking about the survey results.

Takuya	"The average number of items found went down from 20.3 to 19.3, so that means things had improved by the time of the second survey."
Yuka	"But, is it really OK to judge it from the average? Looking at the overall graph, I can't really say that things have improved since the first survey."

Based on the graph, Yuka is right. It is OK to say, "Looking at the overall graph, I can't really say that things have improved since the first survey." Explain why she can say that by comparing the 1st and 2nd survey results shown in her graph.

Party Game Ideas that Both 1st Grade and 6th Grade Students can Enjoy

(Planned by 6th Grade Elementary School Students)

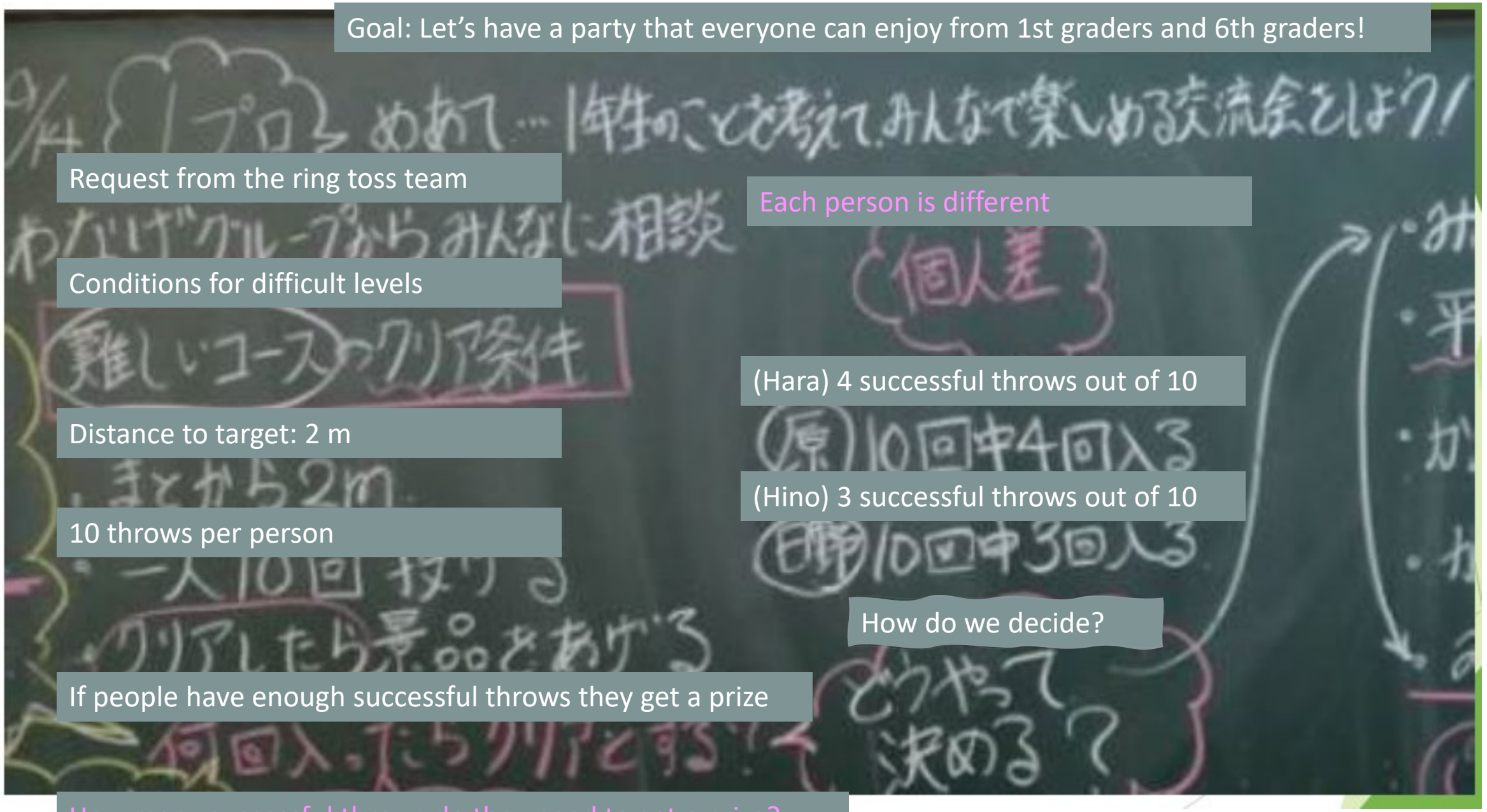
Daisuke Ishikawa
Deputy Principal of Arakawa City Haketa No.9 Elementary School
(Formerly Senior Teacher at Arakawa City Nippori No.1 Elementary School)

Special Event: Party for 1st Grade and 6th Grade Students

Aim decided by 6th graders:

A party that everyone can enjoy!

How can we make it enjoyable for both 1st graders and 6th graders?



Goal: Let's have a party that everyone can enjoy from 1st graders and 6th graders!

Request from the ring toss team

Conditions for difficult levels

Distance to target: 2 m

10 throws per person

If people have enough successful throws they get a prize

How many successful throws do they need to get a prize?

Each person is different

(Hara) 4 successful throws out of 10

(Hino) 3 successful throws out of 10

How do we decide?

How many times do you have to score to get a prize?

C1: Ah, 6 times, 6 times (out of 10).

C2: 4 times.

C3: 5 times.

C4: 6 times.

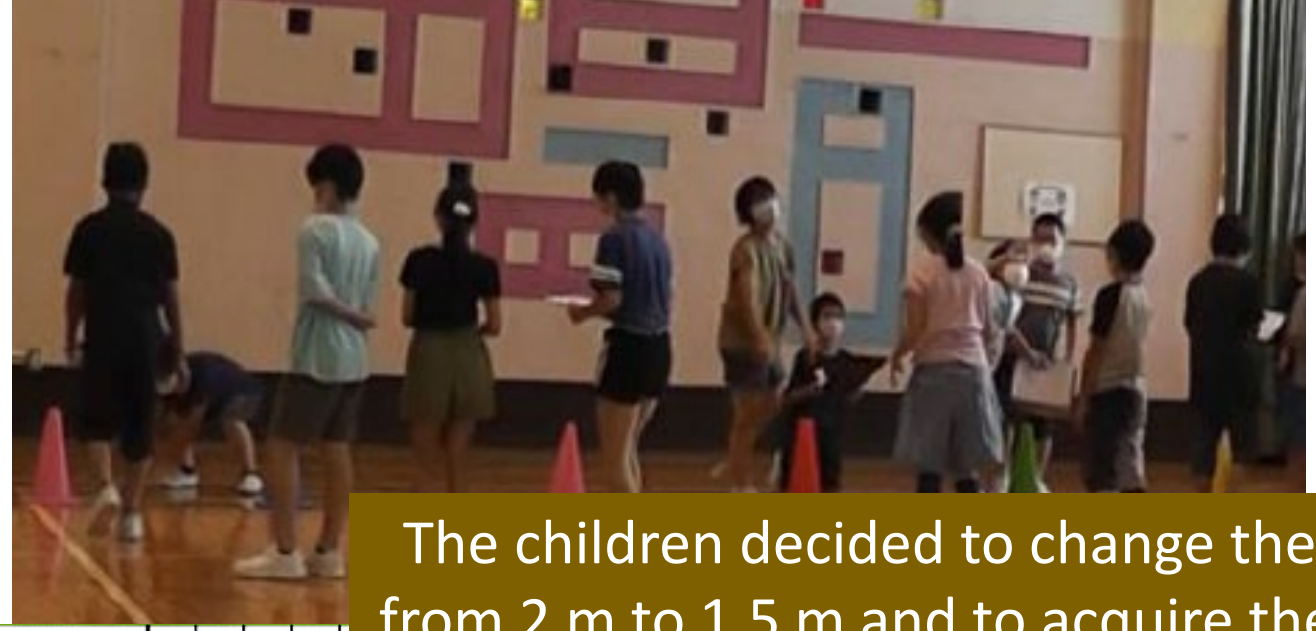
C5: Better than half.

C6: Give them a present if they score more than five times.

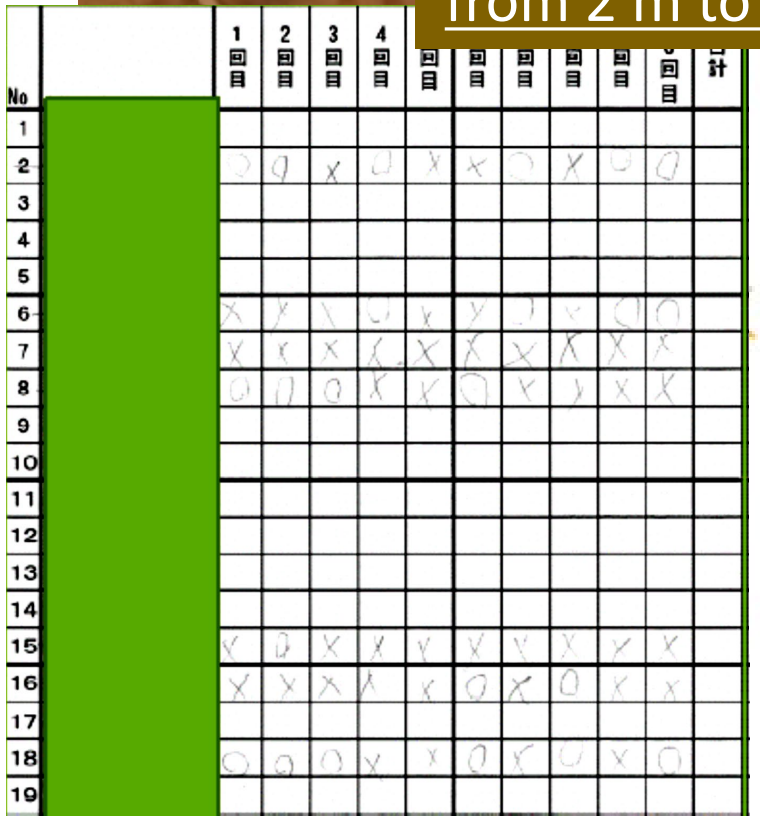
C7: Seriously? 5 times is difficult. I've scored 4 times. Almost everyone scores three or four times....

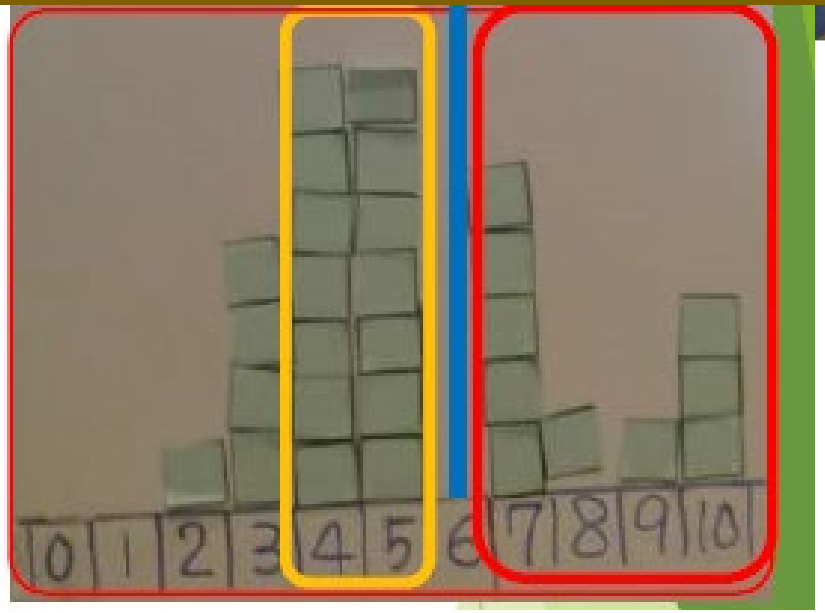
Emotional decisions with no objective basis

Let's collect the data.

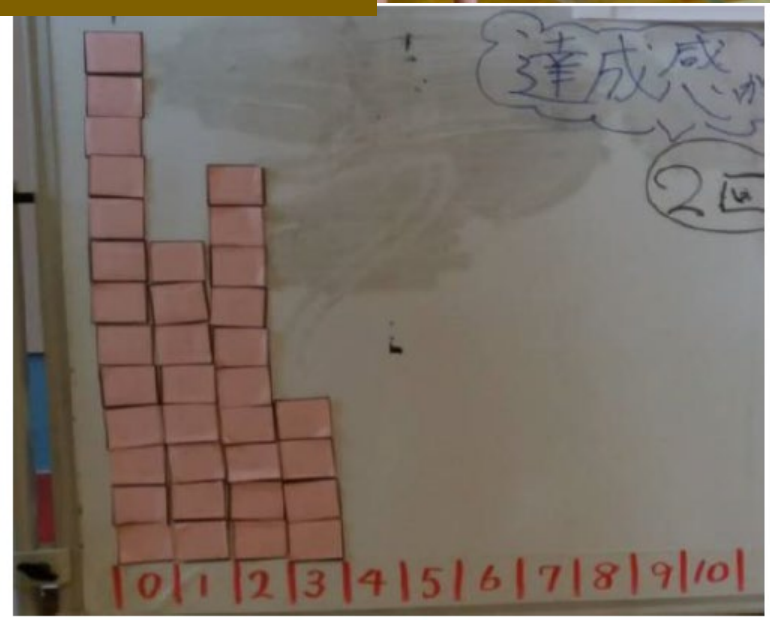


The children decided to change the distance to the target from 2 m to 1.5 m and to acquire the first grade data again.





6th Graders



1st Graders

Final Rules

1st Graders

Distance to target: 1.5 m

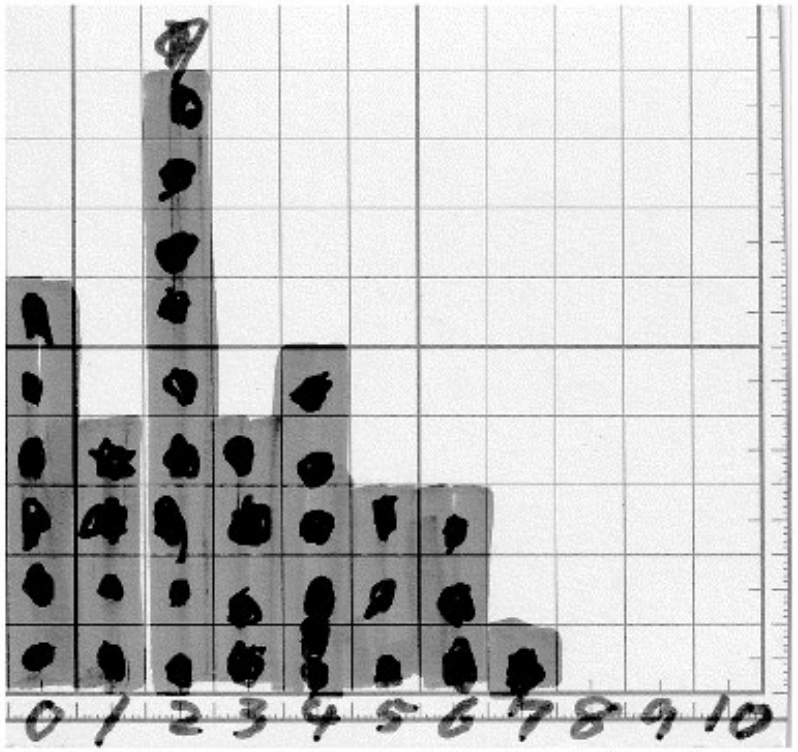
Prize: 3 times out of 10

6th Graders

Distance to target: 2.0 m

Prize: 7 times out of 10

1st Grade Data



Picture of elderly people playing ring toss.

This concept can also be used to create rules for enjoying games with the elderly and people with disabilities.

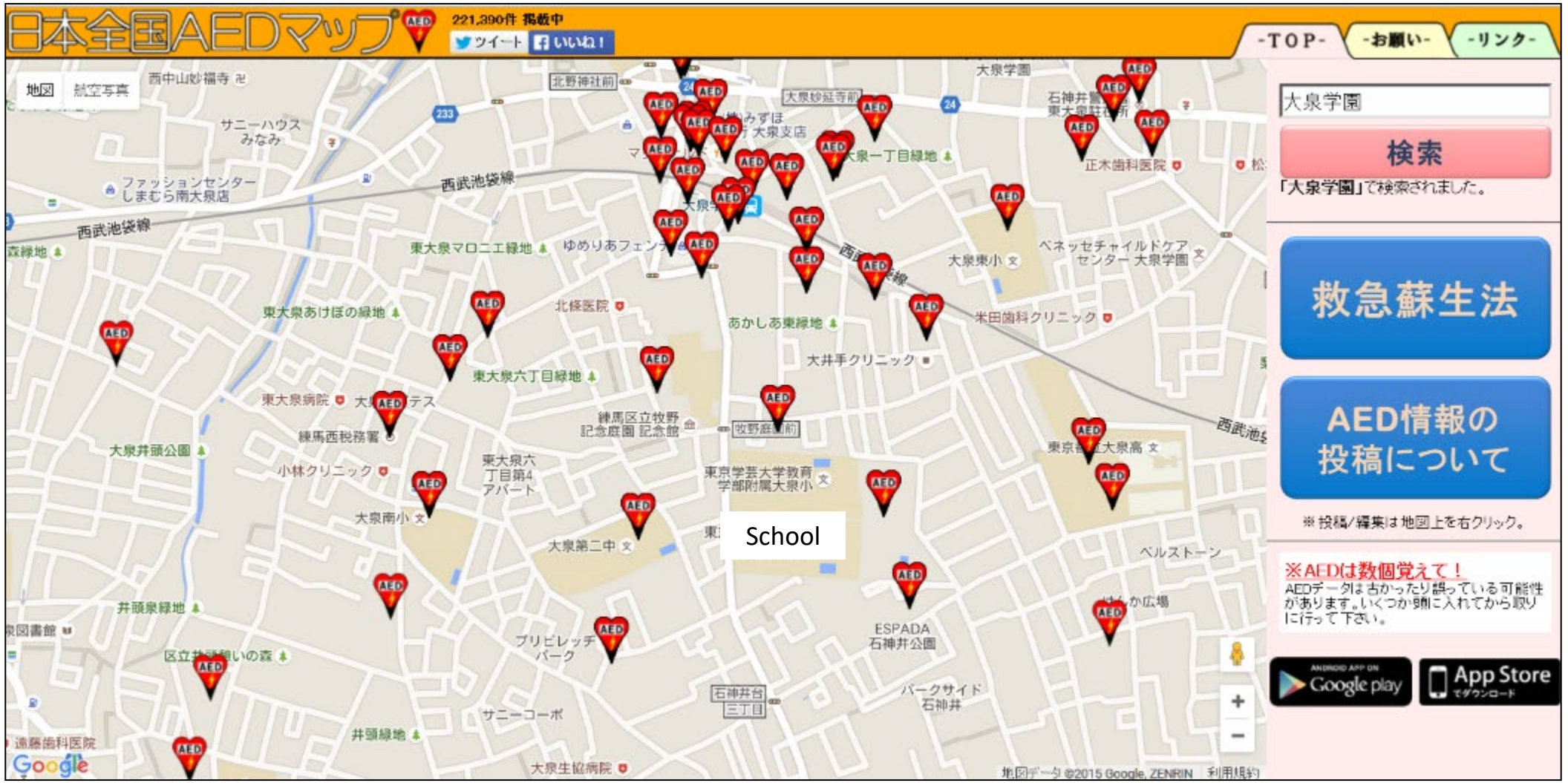
Picture of the “Boccia” competition

More AEDs to Save More Lives

(Planned by 2nd Year Junior High School Students)

Chiharu Honda, Teacher
Tokyo Gakugei University International Secondary School

How many AEDs do we have around the school?



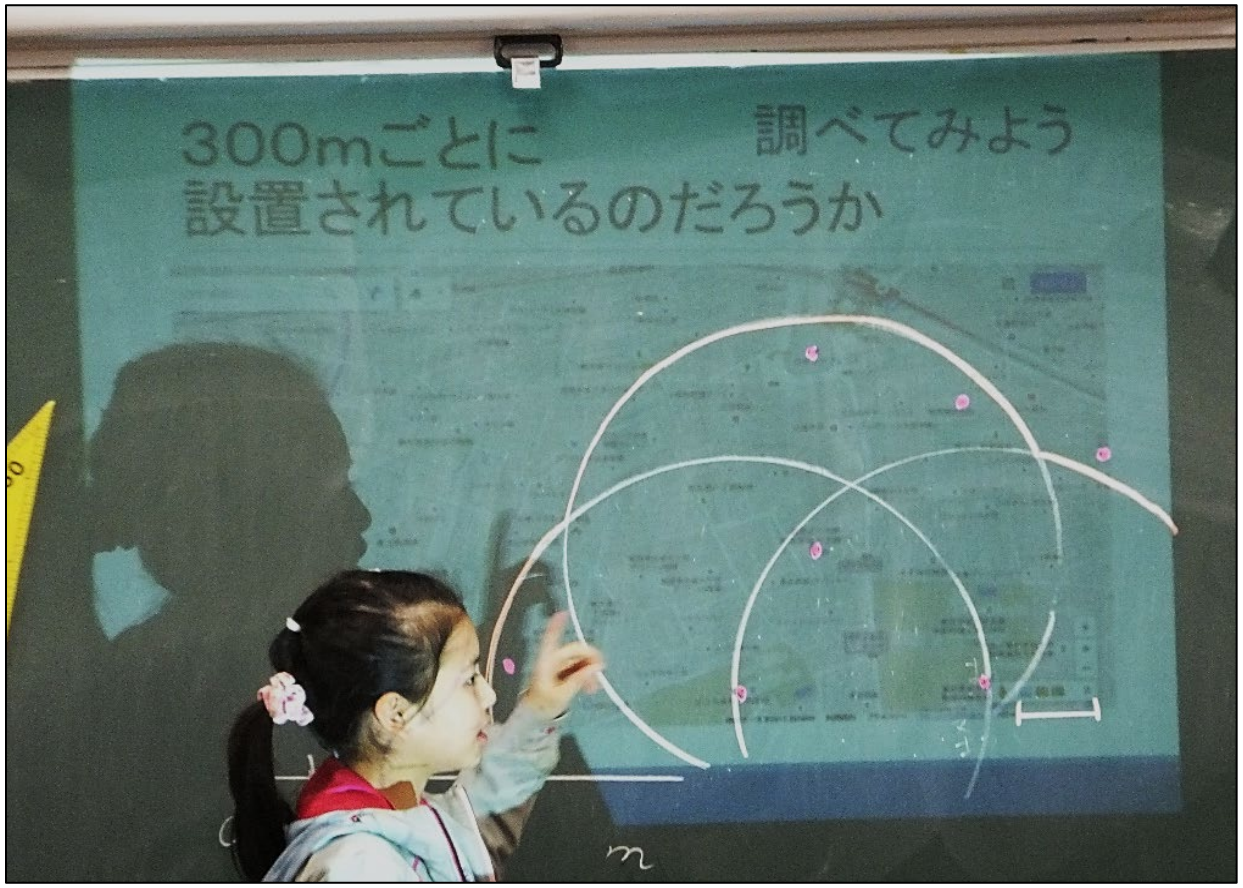
Are there any problems with the location of AEDs?

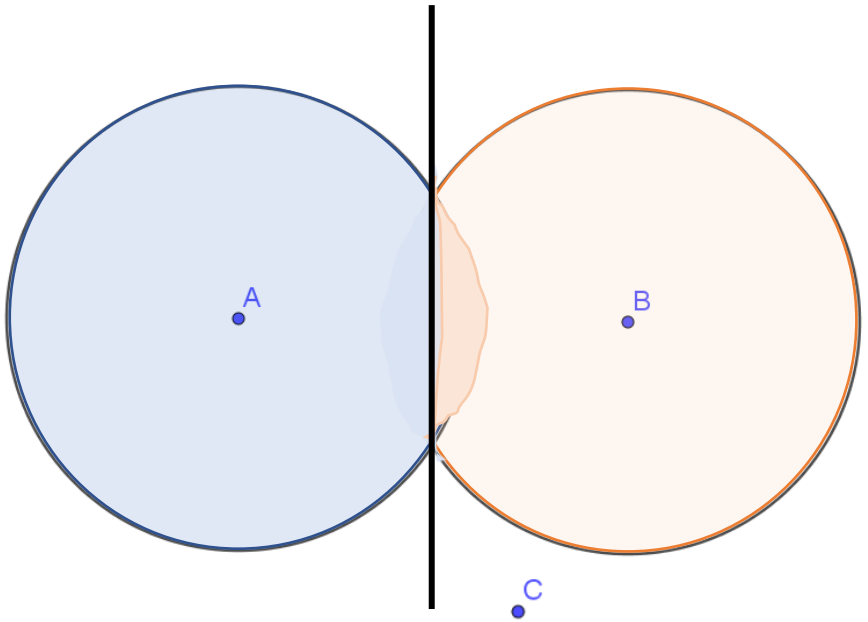
Graph: Relationship between time to start lifesaving procedures and likelihood of saving a life

Graph: Number of AEDs installed, number of AEDs used, and number of witnessed cardiopulmonary arrests

Maybe it would be better to have AEDs placed every 300 m.

Let’s see if AEDs are placed every 300 m.

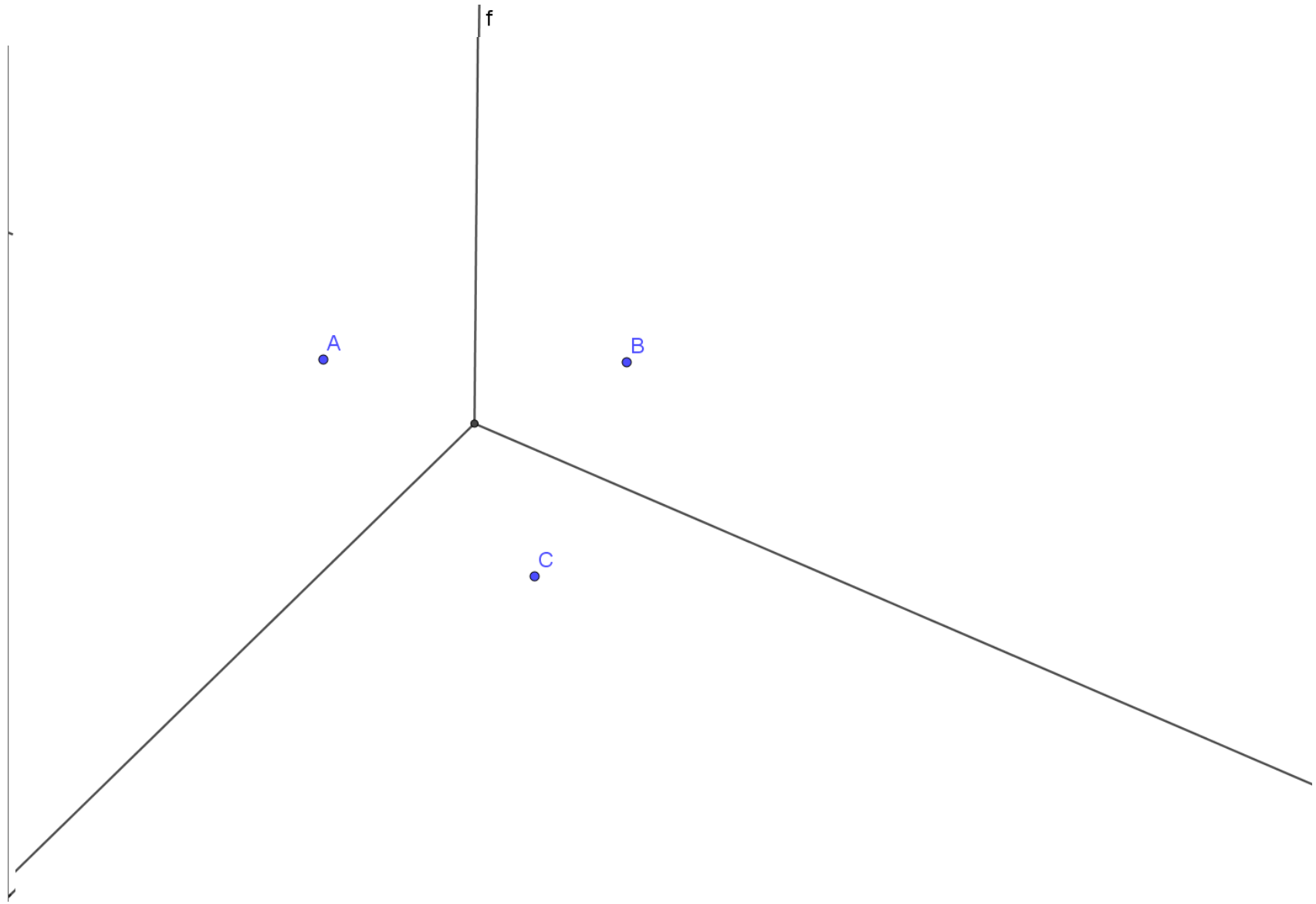




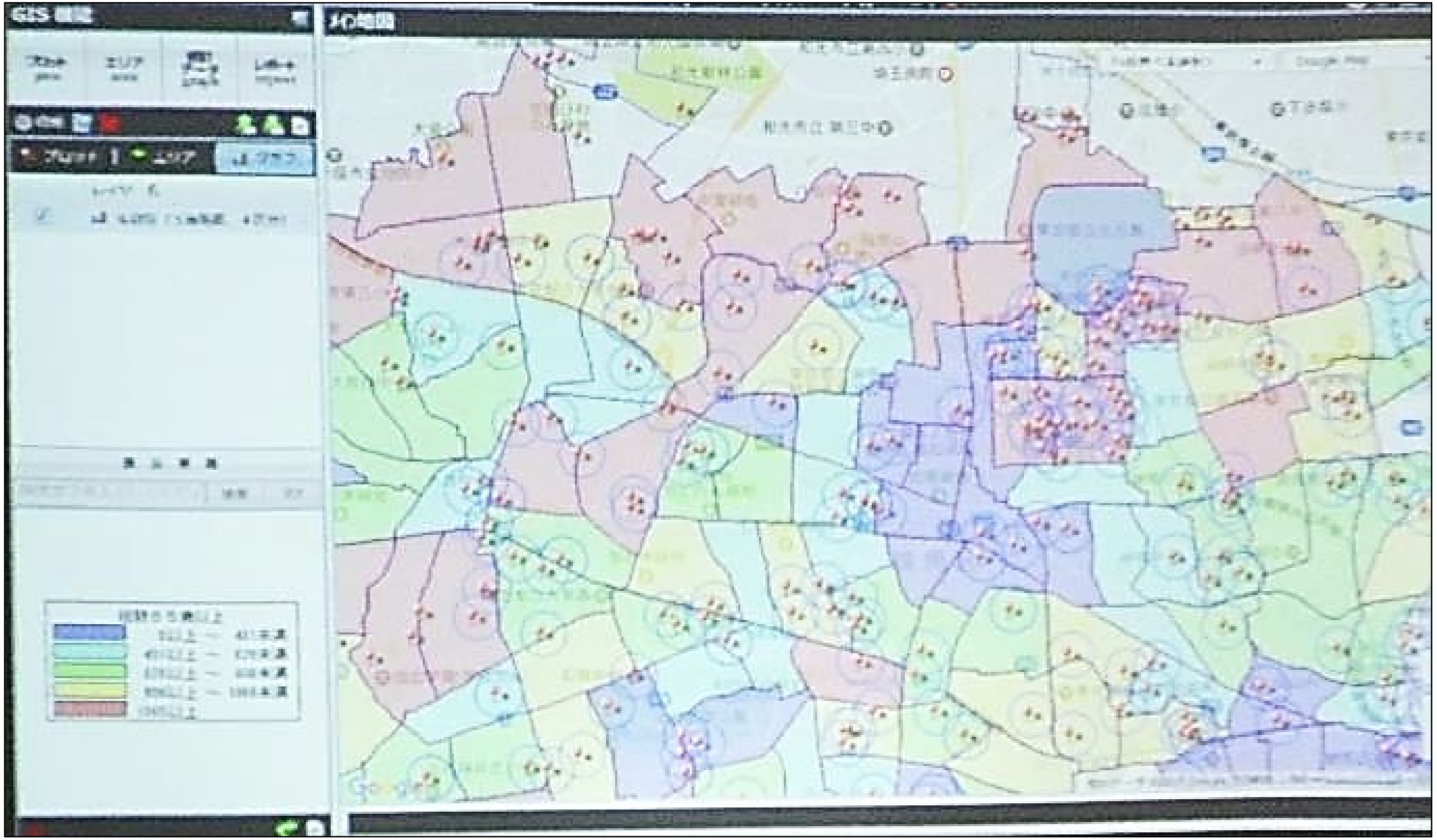
What does it mean when two circle overlap?

ログイン
大泉学園
東大泉マロニエ緑地
東大泉あけぼの緑地
東大泉六丁目緑地
東大泉病院
大泉井頭公園
小林クリニック
区立大泉南小学校
区立大泉第二中学校
東京学芸大学教育
東京学芸大学国際中等教育
あかしあ東緑地
ゆめりあフェンテ
北條医院
アプローズ大泉学園ガレリア
アプローズ大泉学園
大泉パプテスト教会
練馬西税務署
練馬区立牧野記念庭園 記念館
牧野庭園前
学芸大附属中小前
みずほ幼稚園
Google
地図データ ©2015 ZENRIN
利用規約
プライバシー
フィードバックの送信
100 m
1
2
3
4
5
6
7
8
9

School


f
A
B
C

Where should additional AEDs be placed?



The percentage of residents aged 65 years or above are color-coded based on J-STAT.

National Curriculum Standards at High School, Announced in 2009

Utilization of Mathematics

…. In light of the fact that mathematics has been developing in close relationship with culture, there is a need to equip students with the ability to observe events mathematically in the knowledge-based society and the mindset to actively use mathematical knowledge (**so-called "mathematical literacy"**). The mathematics curriculum consists of **(1) Human Activities and Mathematics, and (2) Mathematical Consideration in Real-life Situations**.

A. Mathematics and Social Life
B. Devising of Mathematical Representations
C. Data Analysis

Guidelines of National Curriculum Standards at High School
Mathematics Commentary, Announced in 2009, P.59

National Curriculum Standards at High School, Announced in 2018

Mathematics A

Nature of Geometric Figures

Number of Cases and Probability

Mathematics and Human Activities

Mathematics B

Numerical Sequence

Statistical Inference

Mathematics and Social Life

Mathematics C

Vector

Curves on Plane and Complex Planes

Devising of Mathematical Representations

Contexts

- Personal
- Occupational
- Societal
- Scientific

Mathematical Literacy

Data Literacy

Digital Literacy

Mathematics

Technology and Home Economics

Informatics

Social Studies

Geography and History

Civics

• • •