JAPANESE LESSON STUDY AND PROBLEM SOLVING APPROACH

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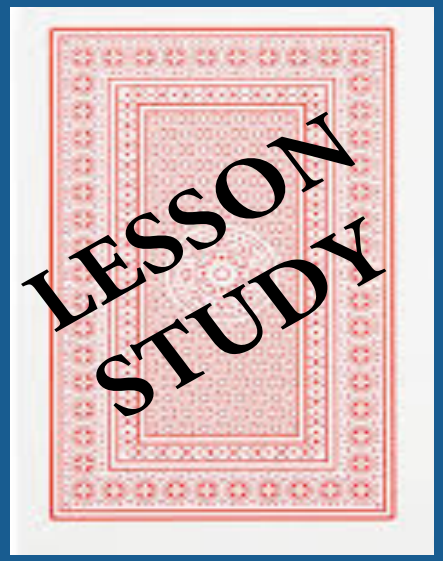
JAPANESE CONTEXT OF MATHEMATICS TEACHING IN PRIMARY SCHOOL



MATHEMATICAL THINKING

How do these specificities translate into teacher's practices?

Baba, Ueda, Ninomiya & Hino (2018)
Batteau & Miyakawa (submitted); Fujii (2018)
Isoda (2012); Takahashi (2006)

THEORETICAL FRAMEWORK

- A double didactical and ergonomical approach: to analyse teachers' practices related to students' activities (cognitive and mediative components of practices) and in taking into account professional aspects (personal, social and, institutional components)
- Cognitive component: "a teacher's choices regarding content and tasks, including their organization, their quantity, their order, their inclusion within a curriculum beyond the class period, and plans for managing the class period". (Robert & Hache, 2013, p. 51)

Robert & Rogalski (2002)
Robert & Hache (2013)

RESEARCH QUESTION

How do the specificities of practice of lesson study and the importance of mathematical thinking translate into the cognitive component of teacher's practices (choice of tasks and their organisation) ?

NORIKO'S PRACTICES

CONTEXT OF NORIKO'S PRACTICES

School	designated school of research by the Ministery of Education
Annual school research theme	logical thinking (in mathematics, science, Japanese...)
LS theme in mathematics	to develop the logical thinking of students: the ability to explain with arguments
Teacher	called Noriko, 2 years of teaching experience
Class	class of 35 students in 3rd grade class (students of 8-9 years old)
Lesson (observed)	research lesson during a lesson study at part of prefectural level Geometry
Lesson study meetings (observed)	2 meetings before the lesson, 2 meetings after the lesson

DATA

April 2018 — 7 dec. — 9 Jan. 2019 — 25 January — 26 June

Ordinary lessons of the sequence « Hint of shadow », not observed

Research lesson - kenkyukai at the prefectural level – observed

Ordinary lesson of the sequence « Hint of shadow » not observed

1 … 7 | 8 | 9

Meetings pre LR Not observed

Meeting pre LR (25 dec) Not observed

Meeting 1 pre RL

Meeting 2 pre RL

Meeting 3 post RL

Meeting 4 post RL

KIND AND COLLECT OF DATA – WRITTEN DATA

Lesson plan v1

Lesson plan v2

Lesson plan v3

Blackboard
Posters in the classroom relevant to the *matome* of lessons 1 to 7

Teacher's report of the lesson

DATA

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Ordinary lessons of the sequence « Hint of shadow », not observed

1 … 7

Meetings pre LR Not observed

Meeting pre LR (25 dec) Not observed

Meeting 1 pre RL

Meeting 2 pre RL

Research lesson - kenkyukai at the prefectural level – observed

8

Meeting 3 post RL

Ordinary lesson of the sequence « Hint of shadow » not observed

9

Meeting 4 post RL

KIND AND COLLECT OF DATA – VIDEO DATA

Videos recording of the research lesson and the meetings, transcribed in Japanese (by a Japanese professional) and translated in English/French (help with google translate)

Video of the post LR meeting (not transcribed yet)

CHOICE OF TASKS AND ORGANISATION

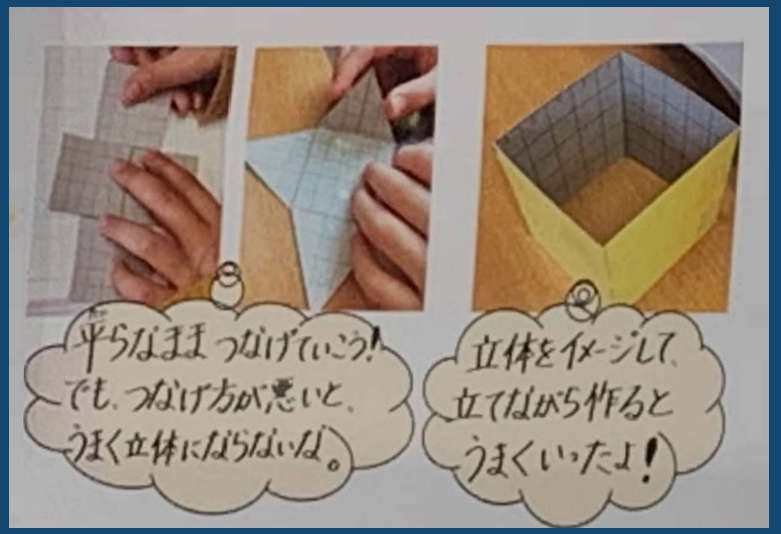
Noriko (Meeting 1 Pre RL)

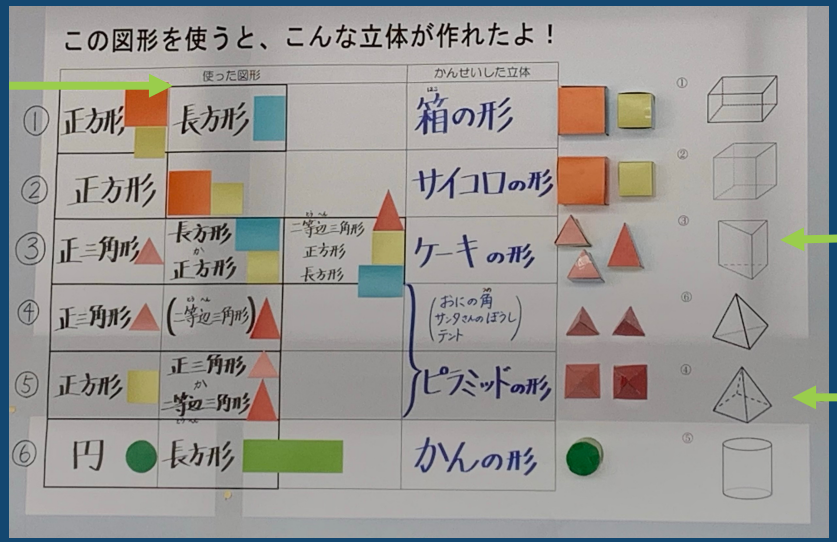
> « As expected, I think the important elements are the faces. When I looked at the 2nd and 4th year textbooks before and after (3rd year), as expected, I found that we spend time on the tops and edges of the solids rather than on the faces. *(Kyozaikenkyu)*
>
> We will assemble the shapes of the faces. Children understand little by little that they can name and make the solid. Because in reality we are gathering the parts of the solid, I would like to do a solid building activity. At that time, I would like students to keep in mind that when we use this kind of solid, we used this kind of face for example. »

CHOICE OF TASKS AND ORGANISATION - LESSON PLAN (EXTRACT) – POSTERS (EXTRACTS) – LESSONS 1-2-3

	Number of lessons	Lessons n° 1-2-3 Learning activity
To build a solid	3	1. To manage the faces to build a solid (with freedom) 2. To use the choosen faces to build a solid 3. To describe the solid

faces





« cake »

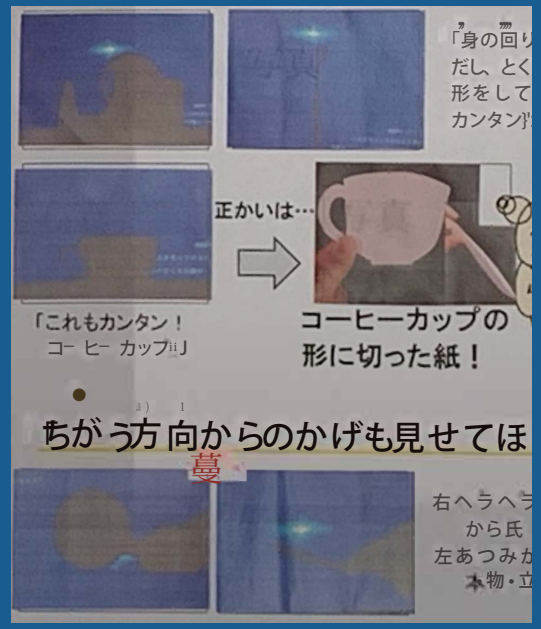
pyramid

Noriko (Meeting 3 post LR)

« To begin with (lessons 1-2-3), we spent time with things around us, from what their characteristics were, it's like making reasonings, giving explanations, it's like doing an experiment »

CHOICE OF TASKS AND ORGANISATION
LESSON PLAN (EXTRACT) – POSTERS (EXTRACTS) – LESSON 4

	Number of lessons	**Lesson n° 4 Learning activity**
Quiz of solid (1)	1	The object is projected in 1 direction To watch the shadows



A cup of coffee projected in different directions: front, top

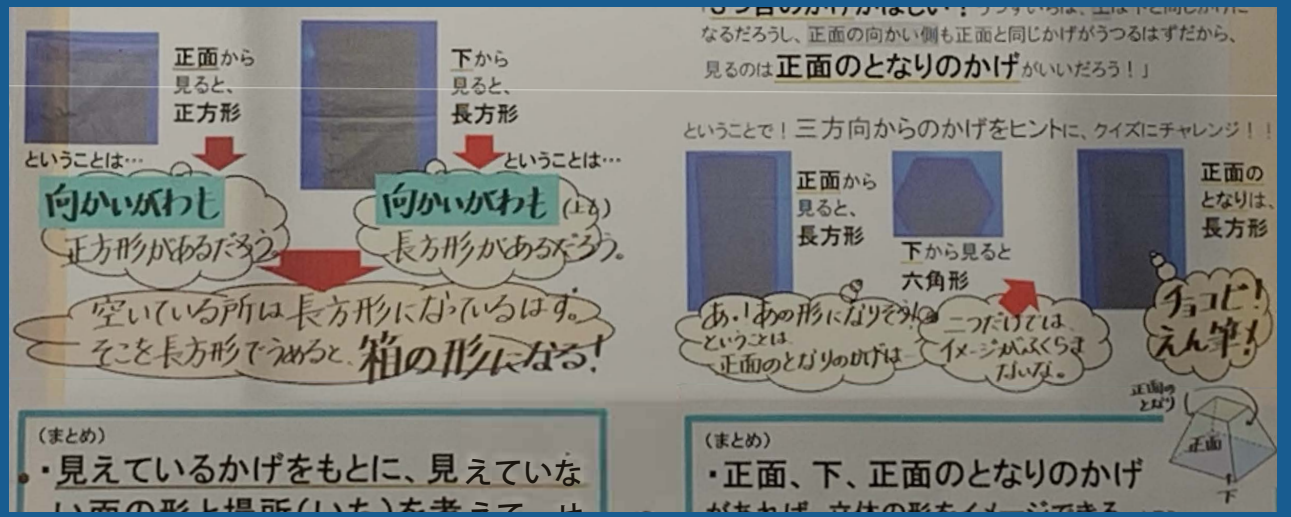
CHOICE OF TASKS AND ORGANISATION
LESSON PLAN (EXTRACT) – POSTERS (EXTRACTS) – LESSONS 5-6-7

	Number of lessons	Lessons n° 5-6-7 Learning activity
Quiz of solid (1)	3	The solid is projected in 2 or 3 directions To watch the shadows To find the hidden solid

Noriko (Meeting pre LR)
« After handling a lot of solids (LESSONS 1-2-3), I would like to avoid assembling the faces for example in the quiz whose goal is to find a solid (LESSONS 5-6-7-8) »

2 Conditions (forms and positions)

3 Conditions (forms and positions)



CHOICE OF TASKS AND ORGANISATION LESSON PLAN (EXTRACT)

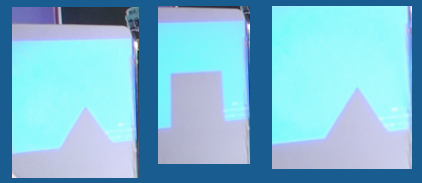
In this unit (research lesson n°8), we use “shadows” to pick up solids and their constituent faces. There are other three-dimensional components, sides and top of a solid, but the important elements for children to grasp a solid are the shape of the surface and its positional relationship. This unit considers the shape of several visible faces and their positional relationships, determines what kind of solid it will be, and explains the imaged solid so that it can be communicated to others.

In order to convey your solid to other students, you can express it by comparing it to things around you and explaining the positional relationship between the faces. It can be regarded as a logical thinking ability.

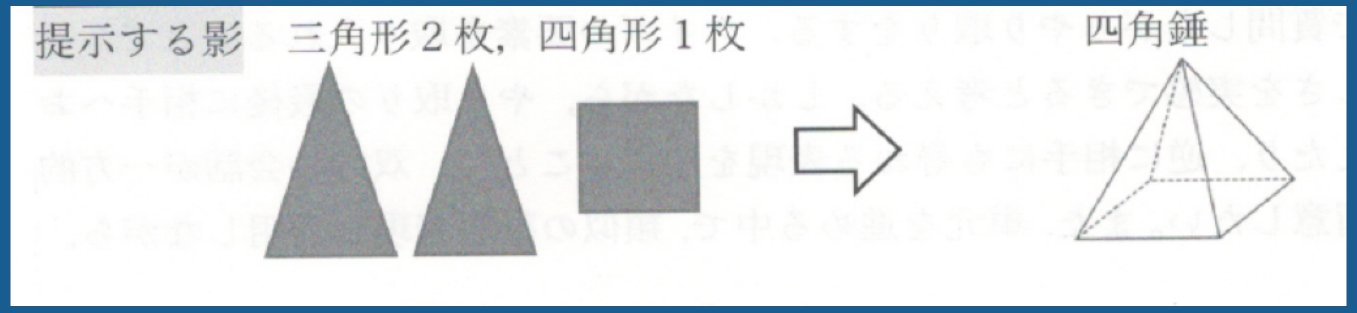
CHOICE OF TASKS AND ORGANISATION
LESSON PLAN (EXTRACT) - RESEARCH LESSON 8

	Number of lessons	Research lesson n°8 Learning activity
Quiz of solid (2)	1 RL	(8) The solid is projected in 3 directions To watch the shadows To find the hidden solid

- Task: in a quiz with shadows, the teacher shows 3 faces of a mystery solid (2 isocel triangles and 1 square), and gives 3 directions (front, below, side). The problem is to find the mystery solid.



- Solution of the task (lesson plan): pyramid with square base



TASK OF THE RESEARCH LESSON: DIDACTICAL VARIABLES

- The solid (cube, pyramid, prism…): here a pyramid
- The position of the faces with shadows (front, below, side, back) – here front, below, side
- The forms of the faces (triangles, squares, rectangles…) – here 2 triangles and 1 square
- The number of given conditions (positions and forms of faces) and associated or not – here 3 positions and 3 forms of faces, but not associated
- The given material to students – here triangles and squares in flexible paper

CHOICE OF TASKS AND THEIR ORGANISATION

Choice of tasks (lessons 1-2-3)

- To build/to name a solid, his faces and the position of his faces
- Manipulation of faces of solid/construction of solids

Choice of tasks (lessons 4-5-6-7- RL 8)

- Same pedagogical material

COGNITIVE COMPONENT
CHOICE OF TASKS AND THEIR ORGANISATION

Kyozaikenkyu
Individual mathematical analysis (textbook and Course of Study)

Individual preparation of the sequence of lessons (lesson plans)

Meetings pre LR
Collective discussions

Focus on the faces and the relationships between faces of the solid

Choices of tasks
- to build/to name a solid, his faces and positions (lessons 1-2-3)
- similar tasks with variation of values of didactical variables (lessons 4-5-6-7-RL 8)

Allow to

To describe/to communicate the solid from the faces

In order to

Develop the Logical thinking of students

KAZU'S PRACTICES

CONTEXT OF KAZU'S PRACTICES

School	an elementary school attached to Joetsu University of Education (*fuzoku*)
School research theme	Inquiry: "a process of developing a way of thinking, acquiring the knowledge and skills, and creating the meanings and values, within pupils through working on the 'materials' and being worked by the 'materials, which are specific to the interaction with the 'materials'"
Teacher	called Kazu, 12 years of teaching experience
Class	Class of 35 students in 3rd grade class (students of 8-9 years old)
Lesson	sequence of 15 lessons about feeling the length, ordinary lessons (1st and 3rd) transcribed/translated the research lesson (8th) of school-based lesson study 1 research lesson at district-based level
LS meetings	RL at school level: not possible to access to LS meetings RL at prefectural level: 1 meeting after the Research Lesson

DATA

« Feeling long lengths »

Weight

Kind of lesson

Ordinary lessons 1...7

Research lesson at the school level

Ordinary lessons 9...15

Research lesson – kenkyukai At the prefectural level

Lesson 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 ... 16

KIND AND COLLECT OF DATA – WRITTEN DATA

Blackboards of lessons 1 to 16

Videos of lessons 1 to 16

Lesson plan

Teacher's report of the lesson

Lesson plan

Video of the post-lesson meeting

Transcriptions in Japanese of the videos 1&3 and translated in English/French

lesson plan and teacher' report received by email
Textbook Teacher's guide
Course of study

ANALYSIS OF KAZU'S COGNITIVE COMPONENT
CHOICE OF TASKS – THE PROGRESS OF THE 15+1 LESSONS

Kind of lesson	Times	Task
Ordinary lessons 1-2-3-4-5 (beginning)	4:50:00	Task 1: To measure the lenght of the corridor of the 2nd floor (around 47m)
Ordinary lesson 5 (end)	2:05:00	Task 2: To measure other lengths in the school (choosen by the students): corridor (1st floor), sports hall, the height between the 1st and the 2nd floor...
Ordinary lessons 6-7-Research lesson 8	3:02:00	Task 3: To measure the tour of the sport field (around 200m)
Ordinary lessons 10-11-12 (beginning)	5:32:00	Task 4: To walk and to measure 1 kilometer
Ordinary lessons 9-12 (end)-13-14-15	4:18:00	Task 5: To measure the distance between the school and a candy shop (around 700m)
Other sequence of lessons Research lesson (Kenkyukai) 16	1:07:00	To measure the weight of different objects

Cognitive component: Variety of students' strategies

Lesson 2 / discussed during the *neriage* lesson 3

5 STUDENTS' STRATEGIES and measuring tools

Lesson 4 / discussed during the *neriage* lesson 5

15 STUDENTS' STRATEGIES and measuring tools

2 rulers of 1 meter

3 rulers of 15cm and 17 cm

stools

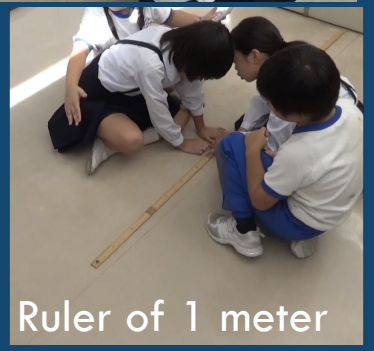
Sticks

Cork board

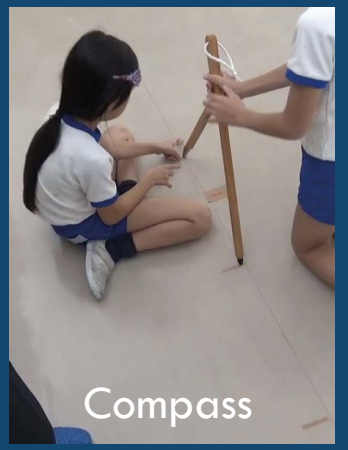
Compass

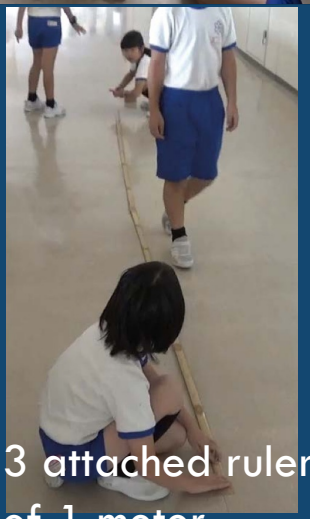
Measuring wheel

Height of a student


Ruler of 1 meter

Mesureing tape: 100m


Compass


3 attached rulers of 1 meter

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COGNITIVE COMPONENT
CHOICE OF TASKS AND THEIR ORGANISATION

Variety of students' strategies

Co-construction for the task 1

Research theme Inquiry

Choice of tasks

- Task 1: Lessons 1 to 5 co-constructed by the teacher and the students
- Task 1: during 5 lessons in order to have a lot of variety of students' strategies
- Task 2: to measure other lengths in the school
- Task 3: to measure the sports field during the lessons 6 & 7 in order to prepare the research lesson 8

Tasks 1-2-3: meso space

Tasks 4 & 5: macro space (town)

Interest of students

Creativity of mathematical activity

Mathematical thinking
Unities: m, km
Measuring methods

CONCLUSION AND DISCUSSION

- Choice of tasks - cognitive component of Noriko's practices and Kazu's practices
  - KEY: Variety of students' strategies MATH THINKING
  - KEY: Variation of the values of didactical variables MATH THINKING
  - Co-construction of the task LS theme
  - Connected to the research theme (logical thinking and inquiry), research objective of lesson study LS theme
  - Idea of training the students before the RL with similar tasks, with tasks of same structures LS
  - Kazu: 1 sequence with school based RL before the kenkyukai (prefectural RL) in the same domain of mathematics (measurement of lengths and weights) LS
- Link with the theory of the variation in Chinese teaching

Thank you!

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