WALS
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Study of teacher's practices during *neriage* phase of mathematics research lesson

Valérie Batteau

Waseda, Tokyo, Japan

3LS, UER MS, HEP Vaud, Switzerland

3LS Laboratoire Lausannois Lesson Study
Lausanne Laboratory Lesson Study

hep/ haute école pédagogique vaud

FNSNF
Swiss National Science Foundation

Problematical issue

French-speaking part of Switzerland (France)

- Importance of individual dimension and differentiation in the teaching
- Difficulties to manage whole-class discussions (« mise en commun », institutionalization)

Batteau (2018)
Charles-Pézard, Butlen & Masselot (2012); Coulange (2013)

Japan

- Importance of collective teaching
- Collective development of mathematical thinking

Takahashi (2008)
Isoda (2012)

How does a teacher manage the whole-class discussion?

Japanese primary school context

- Ordinary practices in primary school: structured problem solving lesson in 4 phases
  - *Hatsumon:* a presentation of the problem, with an estimation, the planification or a prediction of the solution named *mitōshi*
  - *Jiriki-kaiketsu:* students solve the problem individually, then sometimes in groups
  - *Neriage:* whole-class discussion about the methods for solving the problem
  - *Matome:* the summing up by the teacher, with sometimes an extansion of the problem named hatten

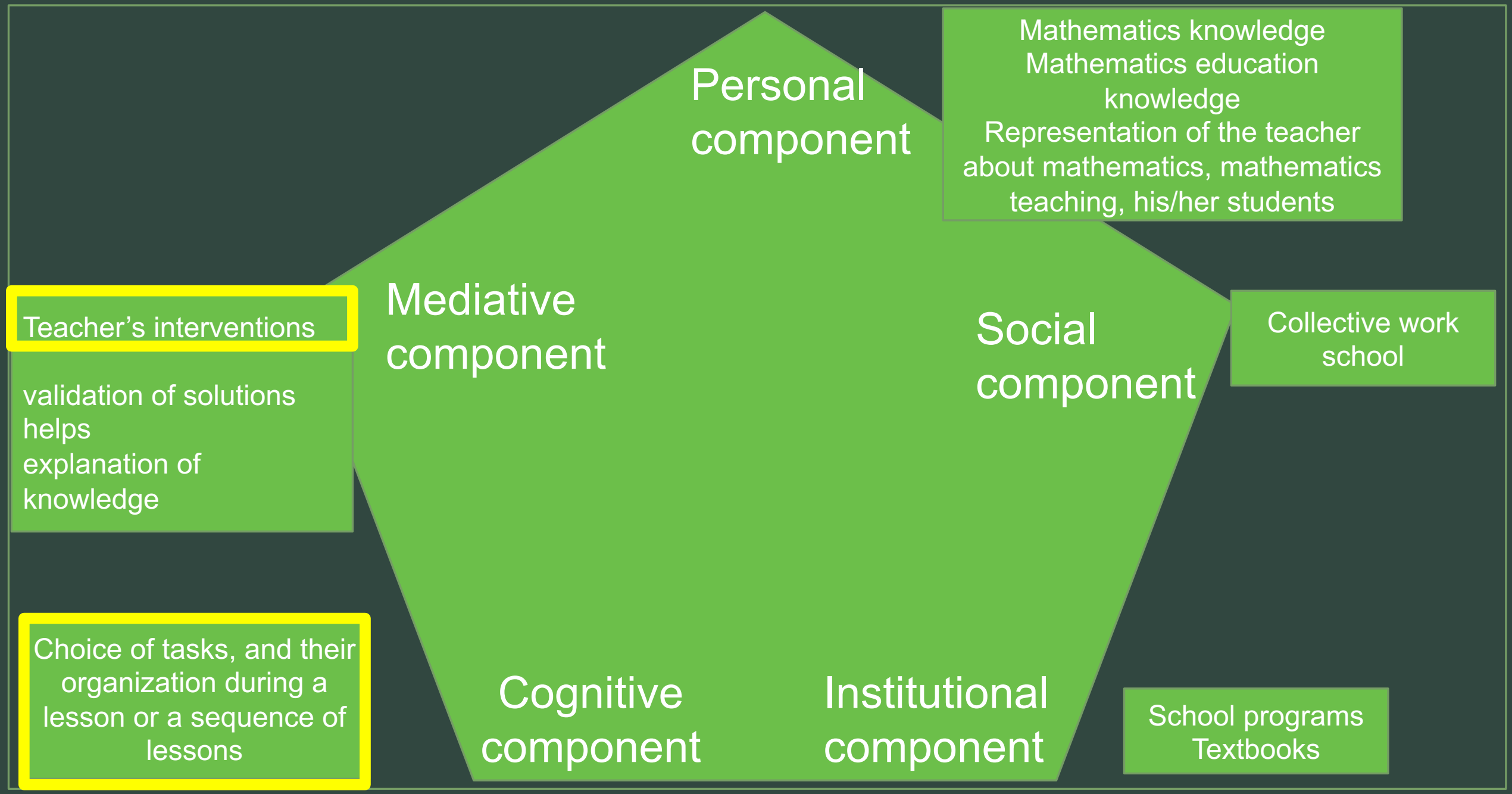
Fujii (2018) ; Isoda (2012) ; Isoda & Nakamura (2010); Miyakawa & Winsløw (2009b) ; Shimizu (2009, 2015); Stigler & Hiebert (1999)

Focus on *neriage*: why?

- Important phase for the collective teaching
- “Critical for the success or failure of the lesson” (Shimizu, 1999, p.110)
- Considered as the heart of teaching mathematics through problem solving (Takahashi, 2008)
- “Dynamic and collaborative nature of a whole-class discussion during the lesson” (Shimizu, 1999, p.110)

Theoretical Framework

- Double approach (Robert & Rogalski, 2005)
  - French didactic of mathematics
  - Ergonomics with the activity theory (Leontiev, 1975; Leplat, 1997)
- Teacher's practices: "all work done by that teacher, whether before, during, or after class time" (Robert & Hache, 2013, p. 25)
- Two closely linked elements are considered to analyze teachers' practices: students' activities and teachers' management of the class (Robert & Hache, 2013; Robert & Rogalski, 2005)


Personal component
Mathematics knowledge
Mathematics education knowledge
Representation of the teacher about mathematics, mathematics teaching, his/her students
Mediative component
Teacher's interventions
validation of solutions
helps
explanation of knowledge
Social component
Collective work
school
Choice of tasks, and their organization during a lesson or a sequence of lessons
Cognitive component
Institutional component
School programs
Textbooks

Research questions

What are specific tasks (*cognitive* component) managed by the teacher and the teacher's interventions (*mediative* component) during the *neriage*?

Noriko’S PRACTICES

- Methodology: context, kind and collect of data
- Analysis of the cognitive and mediative components

Context of Noriko's practices

School	designed school of research by the Ministry 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 in space
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

1 ... 7

Research lesson - kenkyukai at the prefectural level – observed

8

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

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

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

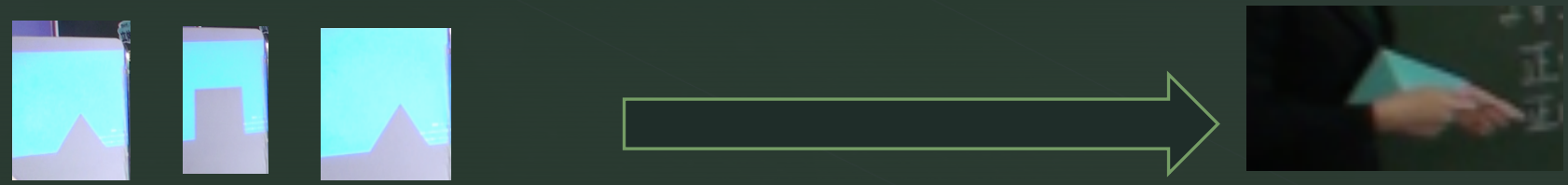
Teacher's report of the lesson

Videos recording of the research lesson and the meetings 1-2-3, transcribed in Japanese (by a Japanese professional) and translated in English/French (help with google translate)

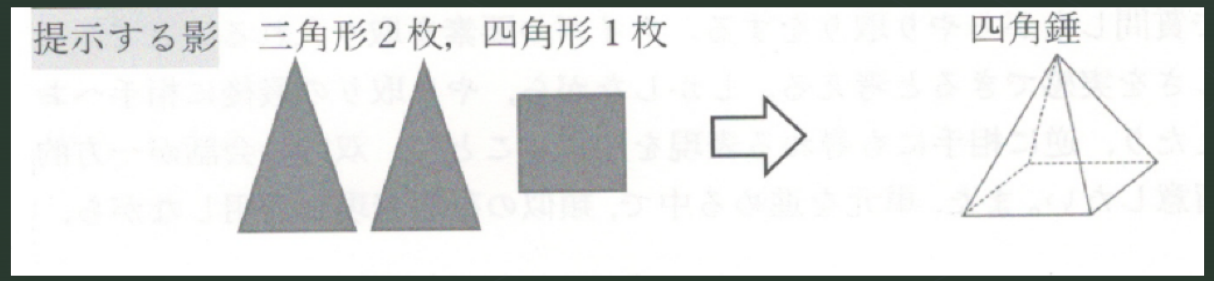
Video of the post LR meeting 4 (not transcribed yet)

Mathematical task (Research Lesson 8)

- Mathematical task: with shadows, the teacher shows 3 faces of a mystery solid (2 triangles and 1 square), and give 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 8: 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

Cognitive component: choice of tasks lessons 5-6-7- RL 8

Same pedagogical material & same form of task (quiz)

Overhead projector

Projected face: square

Research lesson

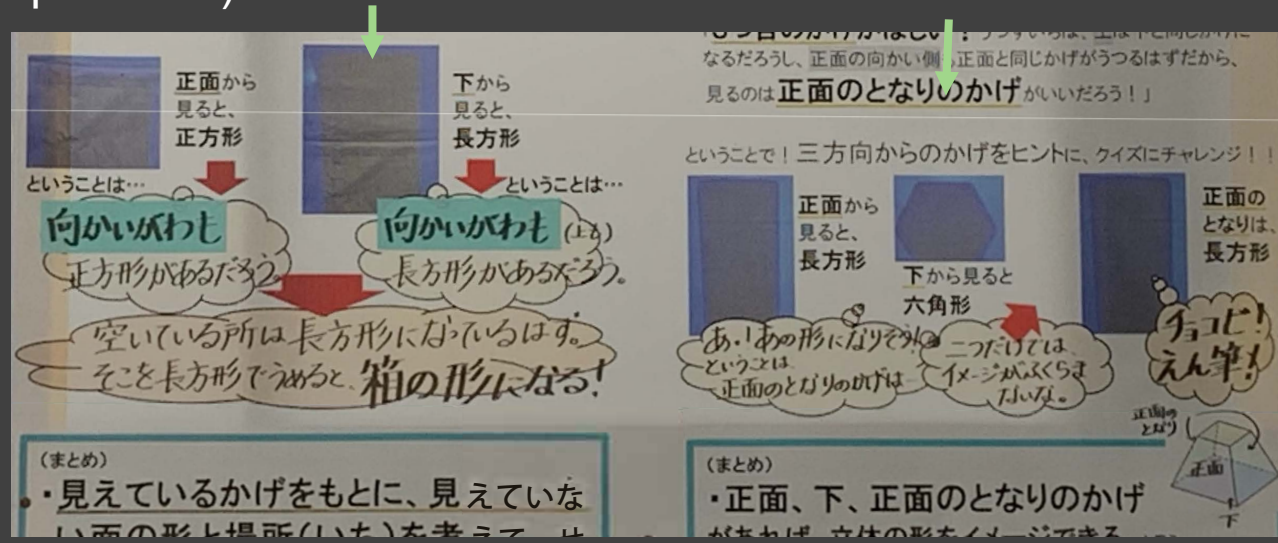
Cognitive component: choice of tasks lessons 5-6-7- RL 8

- Similar tasks by varying the values of didactical variables
  - the solid
  - the number of given conditions (form and position)
  - to attribute or not a shadow with a position

- Lessons 5-6-7: the solid is projected in 2 or 3 directions, the hidden solids are a truncated pyramid, a prism...
- RL 8: the solid is a pyramid and the solid is projected in 3 directions (3 given conditions)

2 Conditions (forms and positions)

3 Conditions (forms and positions)



Posters of the lessons 5, 6 and 7
Displayed in the classroom during the research lesson

Cognitive component
choice of tasks and their organisation

Kyozaikenkyu
Individual mathematical analysis

Individual preparation of the sequence of lessons (lesson plans)

Meetings pre LR
Collective discussions

Extract of the lesson plan
In the research lesson, we use “shadows” to pick up the solids and their constituent faces. There are other 3D 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 [...].

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

Cognitive component
choice of tasks and their organisation

Kyozaikenkyu
Individual mathematical analysis

Individual preparation of the sequence of lessons (lesson plans)

Meetings pre LR
Collective discussions

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

Choices of tasks
- similar tasks with variation of values of didactical variables (lessons 5-6-7-RL 8)

Allow to

To describe/to communicate the solid from the faces

In order to

To develop the Logical thinking of students

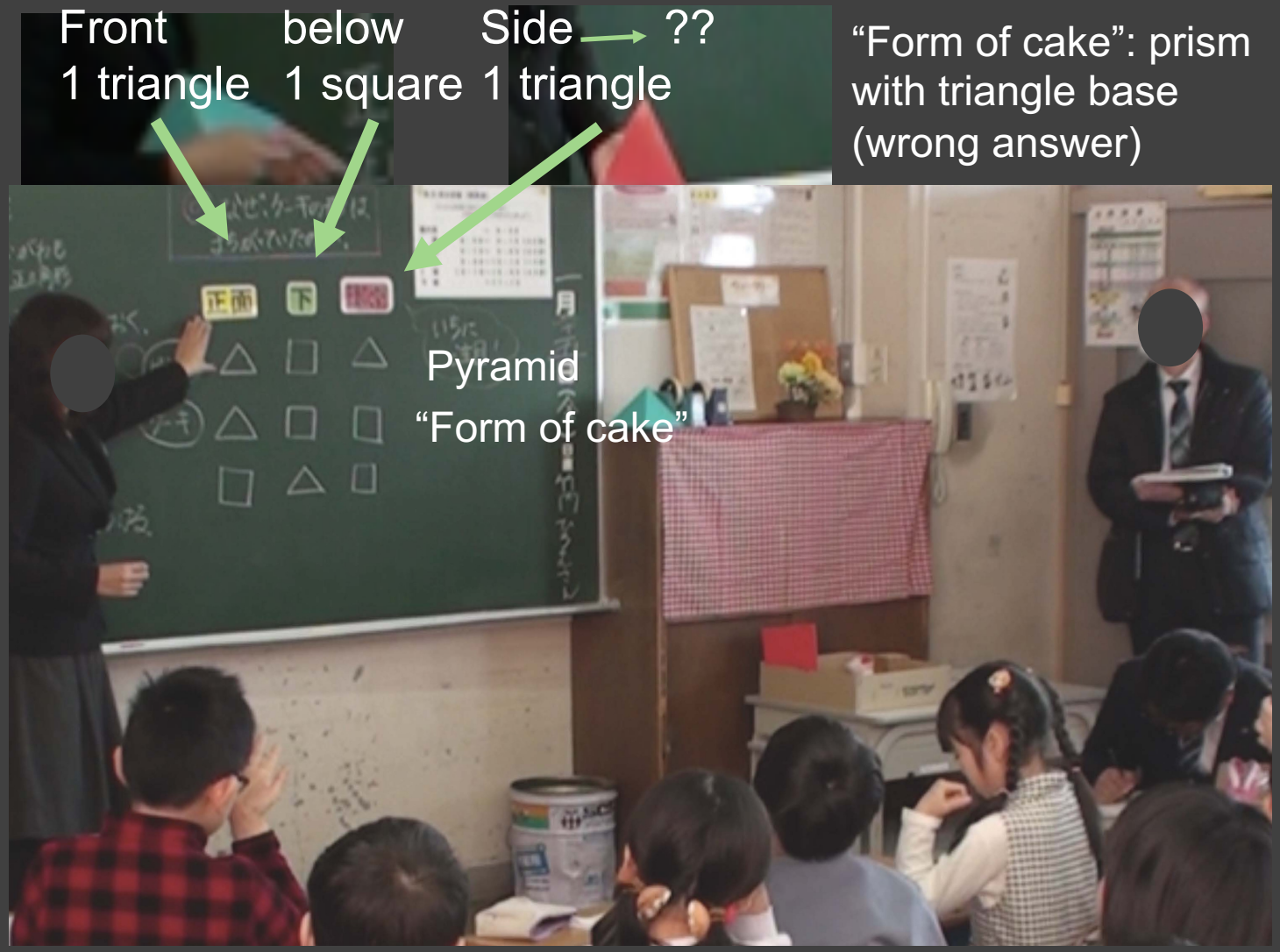
Mediative component: teacher's interventions during the *neriage* variation of the values of didactical variables

51:17 Noriko: […] If you want to have the shape of the cake (prism with triangle base), here it's a triangle, here it's a triangle, here it's a triangle, which position would you like to see here?

51:36 Noriko: When considering the shape of the cake, where the front is a triangle and the bottom is a square, where is the triangle coming?

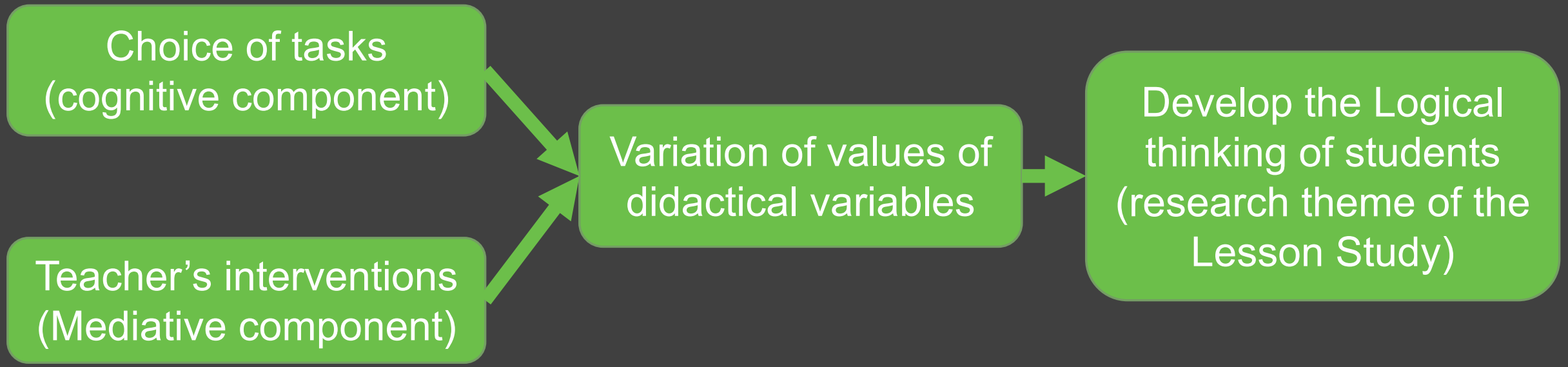
51:45 Student: opposite of the front face?

51:47 Noriko: That's right. […] it's a "cake".



"Form of cake": prism with triangle base (wrong answer)

Key element in the cognitive and mediative components of practices

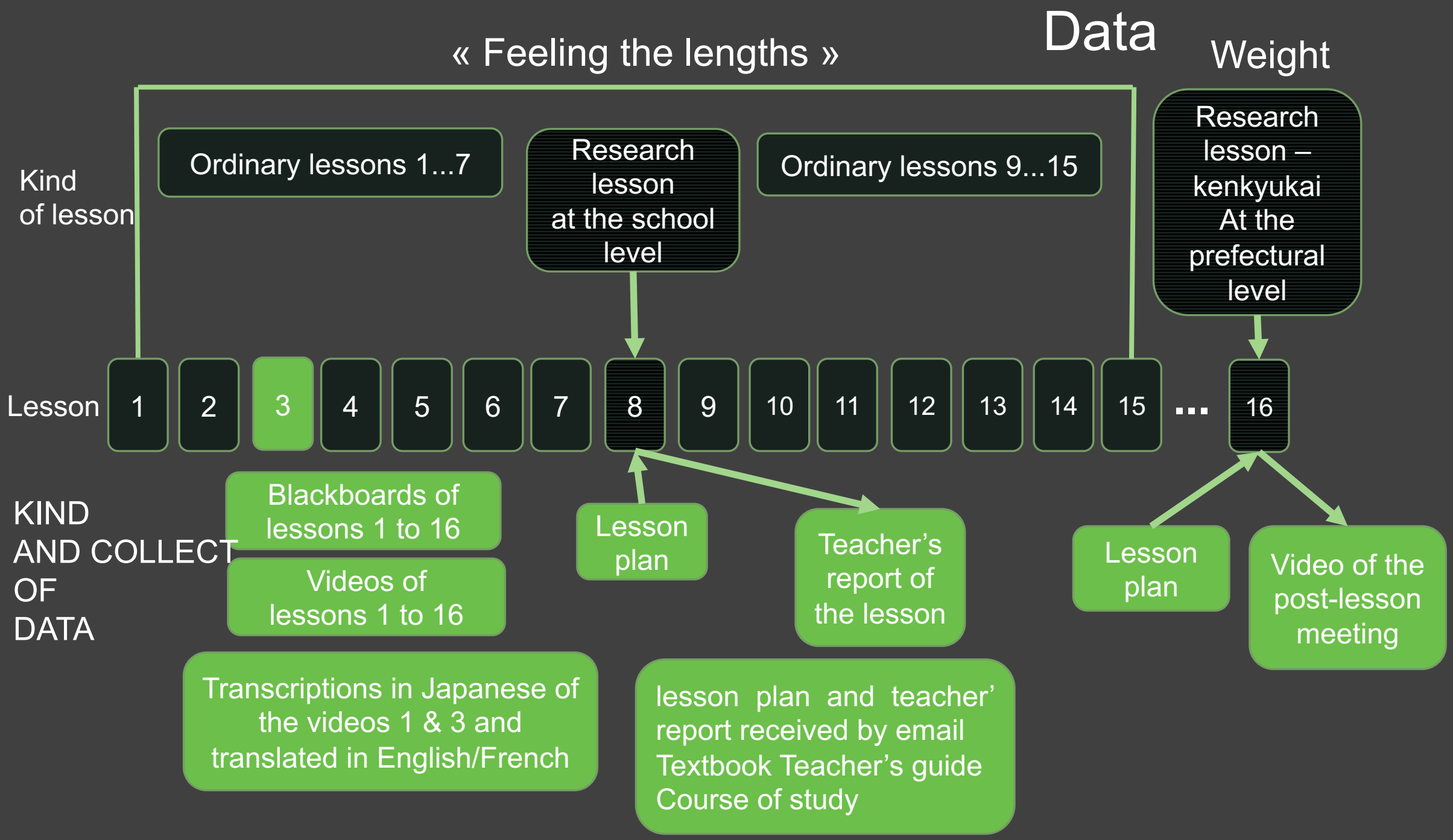


KAZU’S PRACTICES

- Methodology: context, kind and collect of data
- Analysis of the cognitive and mediative components

Context of kazu's practices

School	an elementary school attached to Joetsu University of Education (*fuzoku*)
School research theme (LS)	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)


« Feeling the lengths »
Data
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
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

Cognitive component
choice of tasks – the progress of the 15 lessons

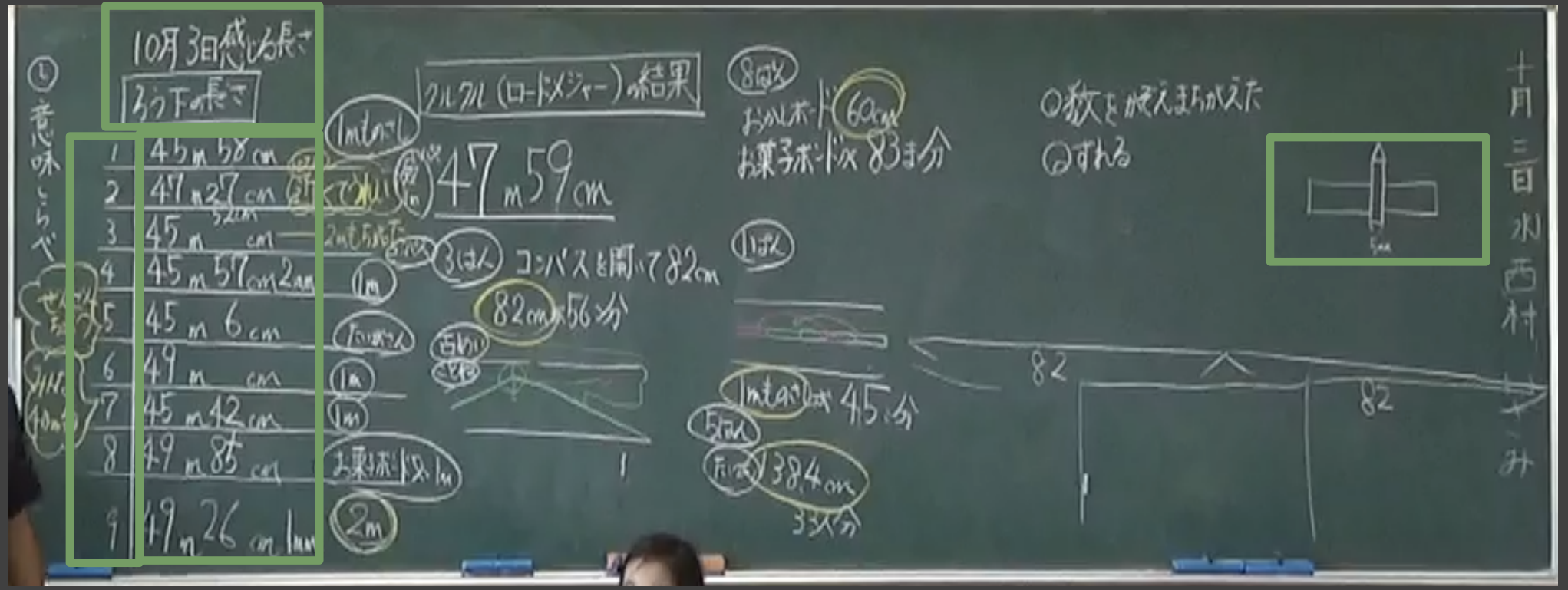
Kind of lesson	Times	Task
Ordinary lessons 1-2-3-4-5 (beginning)	4:50:00	Task 1: To measure the lenght of the corridor of the 2nd floor (around 47m)
Ordinary lesson 5 (end)	2:05:00	Task 2: To measure other lengths in the school (choosen by the students): corridor (1st floor), sports hall, the height 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 sports 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)

lesson 3 (03/10/2018)
Title of the sequence: feeling the length
Title of the lesson: the length of the corridor

Measuring wheel
Highter quality measure
47m59cm

Group 8:
Strategy with a cork bulletin board 60 cm 83 times

To explain difference with the exact measure benchmark between measuring tools
width of a pen 5 mm



Number group of students

length measured ...m...cm

Group 3:
strategy with compass
82 cm 56 times

Group 5: strategy with the height of a student 138,4 cm
33 times

Group 1: strategy with a ruler of 1 meter
45 times

Cognitive component: Variety of students' strategies

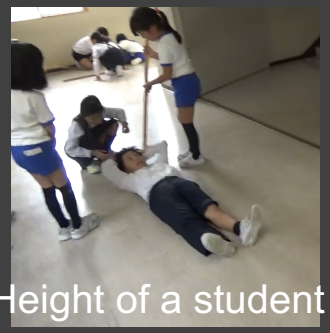
Lesson 2 / discussed during the *neriage* lesson 3

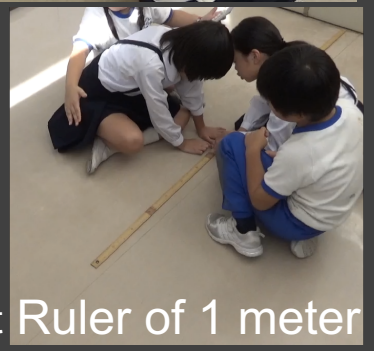
5 STUDENTS' STRATEGIES and measuring tools


Cork board

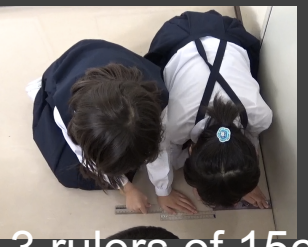

Compass


Measuring wheel


Height of a student


Ruler of 1 meter


2 rulers of 1 meter


3 rulers of 15cm and 17 cm

Lesson 4 / discussed during the *neriage* lesson 5

15 STUDENTS' STRATEGIES and measuring tools


stools


Sticks


Mesureing tape: 100m


Compass


3 attached rulers of 1 meter

...

Cognitive component choice of tasks

Variety of students' strategies

Co-construction for the task 1

Research theme Inquiry

Kazu: What is the length you want to measure in grade 3 this year?
[...]
Kazu: I will ask you something. How long do you think is the length of the corridor? Forecast.

Cognitive component choice of tasks

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

Interest of students

Creativity of mathematical activity

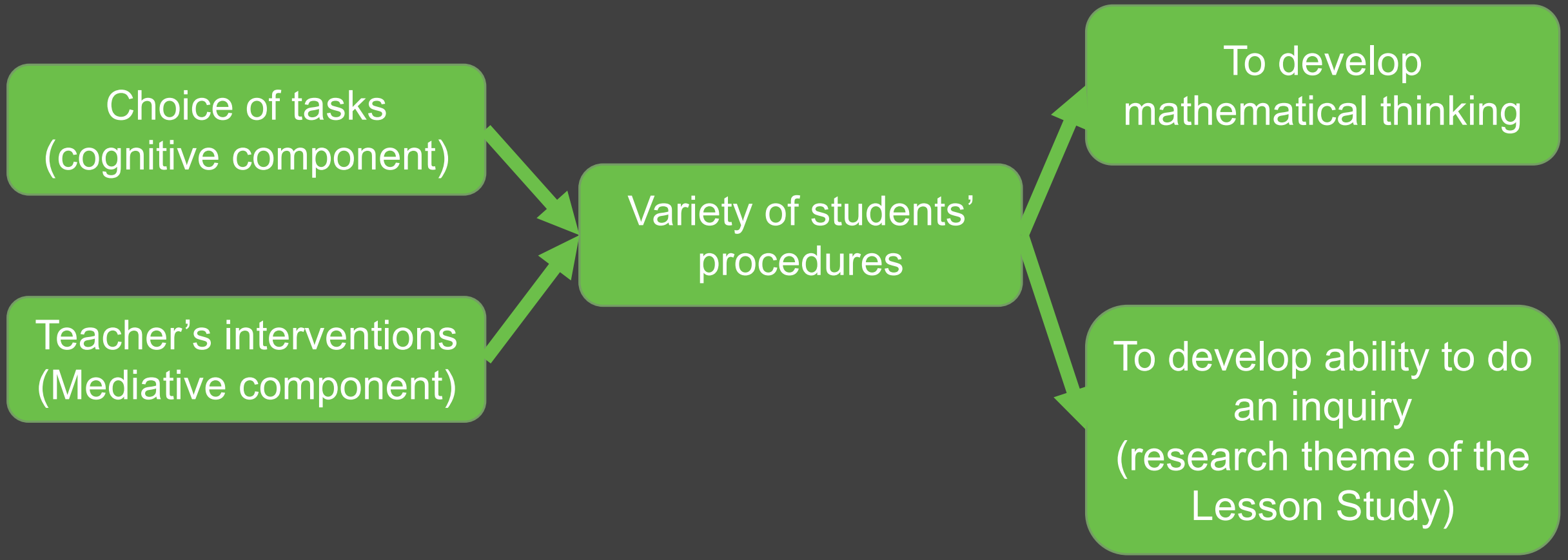
Mathematical thinking
Unities: m, km
Measuring methods

Mediative component: teacher's interventions Comparison of students' strategies

During the *neriage* (lesson 3)

- Presentation of each different students' strategies
- Comparison of students' results between us
  - Teacher: "Can you say that everyone is on the 40 meters' range?"
- Comparison of students' results with the exact result
  - Teacher: "Which is the closest?"
- To develop a reflexive attitude of students about their own strategy
  - Teacher: "Why do you think the result was so different?"

Key element in the cognitive and mediative components of practices



Conclusion

- This study highligths
  - the cognitive and mediative components of Noriko and Kazu's practices can be explained by a same key element: the variation of the value of the didactical variable (Noriko's practices) and the variety of students' procedures (Kazu's practices) during the neriage and for the choice of the tasks
- Problem solving approach: the aim of the lesson is not only to find the solution, but to develop mathematical thinking from the problem
- Noriko's practices: link with the variation theory

Thank you!

valerie.batteau@hepl.ch