



UMR 5191  
Interactions, Corpus, Apprentissages, Représentations

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# **Instructional Use of Multimodal Resources in Explanations During a Scientific Café**

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# 1. THEORETICAL ORIENTATIONS

# Multimodality at the heart of cognitive processes

**'strong' tradition of research** (Kita & Ozyurek, 2003, McNeill, 1992, 2000, Kendon, 2004)

## Metaphor of the multi-channel message achieving a global meaning

- Nature of each 'mode' et *affordances* (Gibson, 1979, Gerwing & Allison, 2009)
- Matters of interdependency and redundancy (e. g. Bavelas, Beavin, Chovil, Lawrie, Wade, 1992, Goldin-Meadow, 2003)

## Each mode may contribute to the 3 interactional goals of

**Coordinating the communication**

**Displaying social affiliation**

**Building semantic structures through the building of reference**

- **primary referential construction** (e. g. Chui, 2005)
- **secondary** (Chui, 2008, Emmorey & Casey, 2001, Gerwing & Allison, 2009, Holler & Beattie, 2003)

# Focus on students' gestures playing a referential function

## Representational gestures

- Provide **embodied images of the referent**
- **Depict a concrete physical referent** by **drawing** in space / **locating** parts of it or tracing its trajectory / **miming** actions (Colletta et al., 2010, Cosnier & Vaysse, 1997, Kendon, 2004, McNeill, 1992, Streeck, 2009)
- Or visual metaphors for **abstract concepts** (Calbris, 2011, Cienki & Muller, 2008, McNeill, 1992)
- Can be **sequentially** organized

## Pointing gestures

- *“a communicative bodily movement which projects a vector whose direction is determined, in the context, by the conceived spatial location, relative to the person performing the gesture, of a place or thing relevant to the current utterance”* (Enfield, Kita, de Ruiter, 2007: 1724)
- **Concrete / abstract**

# Varying the modes of representation for teaching-and-learning

## Multimodality in teachers' discourse: empirical studies

- **Experienced teachers make a greater use** of multimodal combinations (Neill & Caswell, 1993)
- **Gesturing improves the efficiency** of teaching discourse (Alibali et al., 2013, Cook, Duffy, Fenn, 2013, Perry, Berch & Singleton, 1995, Singer & Goldin-Meadow, 2005, Tellier, 2008, Valenzeno, Alibali, Klatzky, 2003)

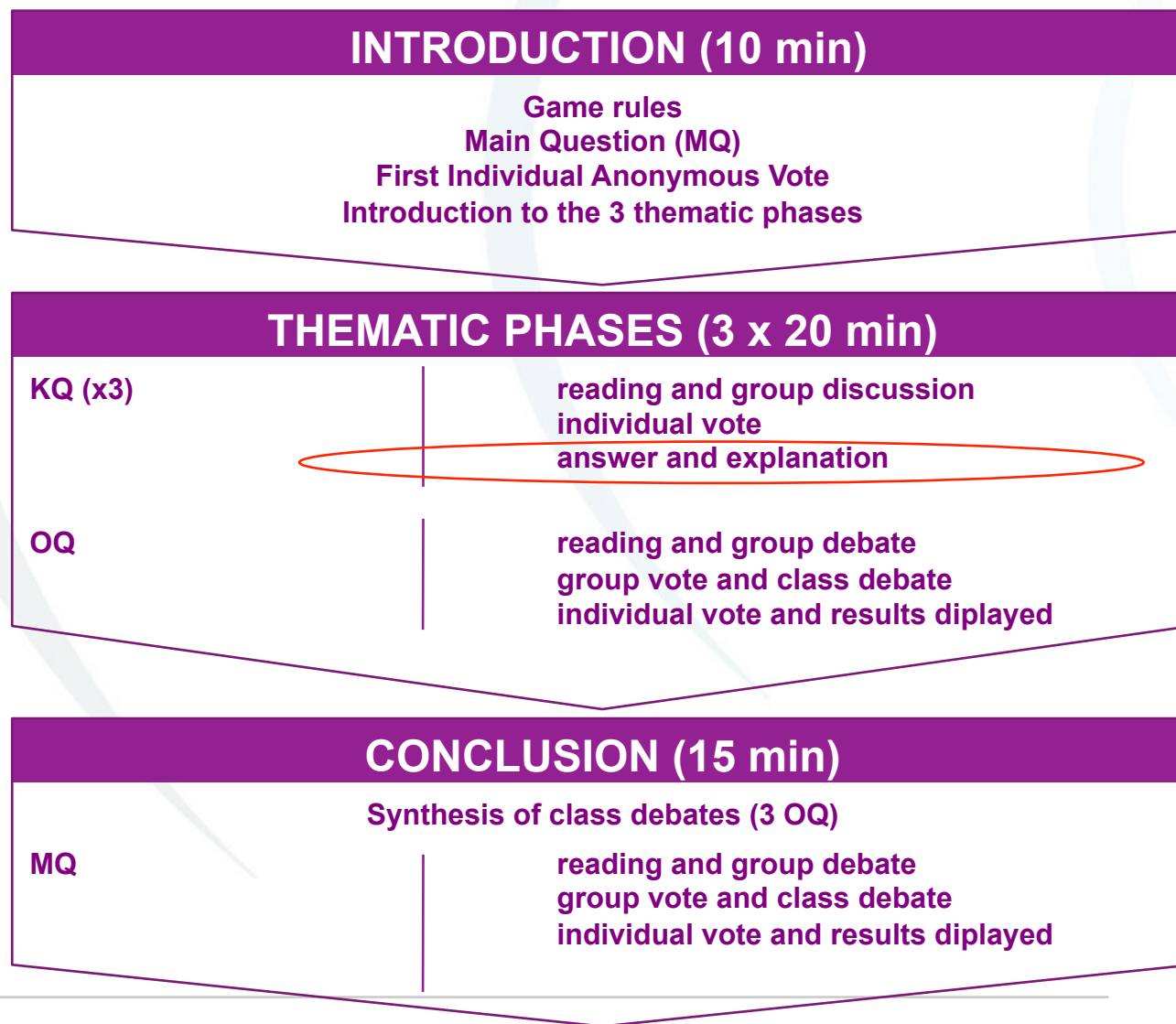
## Interpretation

- A multimodal teaching discourse **provides the students with multiple explanations** of the same concepts through the use of diverse representations (Singer & Goldin-Meadow,, 2005)

## 2. DATA & INSTRUCTIONAL CONTEXT

# The 'scientific café' extracurricular activity (90-120 min)

- ◆ Instructors: volunteer, especially trained students aged 15-17
- ◆ Audience: students aged 12-14
- ◆ At school
- ◆ International environmental education project about drinking water management (E.U., Mexico, France)



**9. Among the following products, which requires the most water, pound for pound, for its production?**

Q1 (English version)

- A** Wheat
- B** Beef
- C** Rice
- D** **Coffee**
- E** Microchips
- F** Apples

**YOUTALK !**

**Information Desk**



Product	Water footprint world average (litres/kg)	Water footprint USA (litres/kg)
1 kg of wheat	1334	849
1 kg of beef	15,497	13,193
1 kg of rice	2291	1275
<b>1 kg of coffee</b>	<b>17,373</b>	4864
1 kg of microchips	16,000	
1 kg of apples	700	

***Pound per pound, worldwide, coffee production uses on average the most water.***

The water footprint of a product varies between countries due to different production practices and local climates.

**SOURCE:** Statistics taken from the scientific journal *Water Resource Management*, "Water footprints of nations: Water use by people as a function of their consumption pattern" by A. Y. Hoekstra and A. K. Chapagain, 2006. The article is available through the [waterfootprint.org](http://www.waterfootprint.org) website at [http://www.waterfootprint.org/Reports/Hoekstra\\_and\\_Chapagain\\_2007.pdf](http://www.waterfootprint.org/Reports/Hoekstra_and_Chapagain_2007.pdf)

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**YOUTALK !**

got water ?





## Q2 (English version)

**12. Which of these statements is true for people living in a shantytown in Manila (Philippines) without indoor plumbing?**

- A** They pay 10 times more than someone in Manila who has indoor plumbing.
- B** They pay 4 times more than a middle-class resident of Manhattan
- C** They pay 4 times more than a very rich resident of Manhattan
- D** They pay \$3.00 per cubic meter (in Kenosha, the price is \$0.68/m<sup>3</sup>).
- E** **All of these statements are true.**
- F** None of these statements are true.

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\_\_**YOUTALK !**\_\_

got water ?



## Q2: explanatory slide

### Information Desk



*All of these statements are true.*

Relatively little information is available on the household budgets of the poorest people on the planet. Nevertheless, the studies that are available tend to show that :

- people living in shantytowns in the developing world buy their drinking water at the highest price in the world, from tank trucks and from street vendors
- in cities, there can be very sharp differences in prices depending on whether one is connected to local water networks or not
- drinking water in shantytowns costs even more than it does in the world's richest countries, where people have greater access to local water networks.
- In general, once one is connected to local water networks, household users all pay the same price, regardless of whether they are rich or poor.

**SOURCE:** Kevin Watkins (dir.) United Nations Development Programme, « Beyond scarcity: Power, poverty and the global water crisis », *Human Development Report*, 2006



## Data

	Instructor	Question	Time spent on the slide	Time of explanation
<b>USA</b>	Cathy	Q1	1 min 26	50.1 sec
		Q2	2 min 16	1 min 25
	Marlene	Q1	1 min 46	45.6 sec
		Q2	2 min 40.4	1 min 34.4
	Iris	Q1	26 sec	26 sec
		Q2	1 min 02	48.7 sec
<b>FRANCE</b>	Sylvie	Q1	2 min 53.4	44.8 sec
		Q2	1 min 48	48.3 sec
	Océane	Q1	1 min 30	1 min 01.6
		Q2	2 min 24	1 min 30.8
<b>Total</b>			<b>18 min 12 sec</b>	<b>9 min 55.2 sec</b>

# 3. METHODOLOGY

## Research questions

1. How do instructors use multimodal resources to mediate the concepts that they have to explain to the students?
2. What are the effects of the multimodal combinations that they use regarding the referential construction of the involved concepts and the information provided to the students?
3. Are there any major cross-individual differences or styles in their multimodal explanation performance that may have instructional effects across languages?

## Analyzing instructors' performance of *mediation*

◆ **Mediation:** explanatory discourse supplementing the 'information desk' slide in order to help the students understand the concepts

◆ **3 types of semiotic resources:**

1) Data written on the slide (text & table)

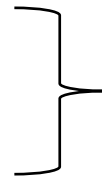
2) Speech: addition of wordings and verbal *mediation* of the slide content

3) Gestural behavior (using ELAN):

- attention focus (gaze & head orientation)

- representational gestures

- pointing gestures



Co-occurring with a mediating verbal sequence

◆ **Characterizing instructional explanatory practice as a multimodal performance combining a diversity of semiotic resources (case studies)**



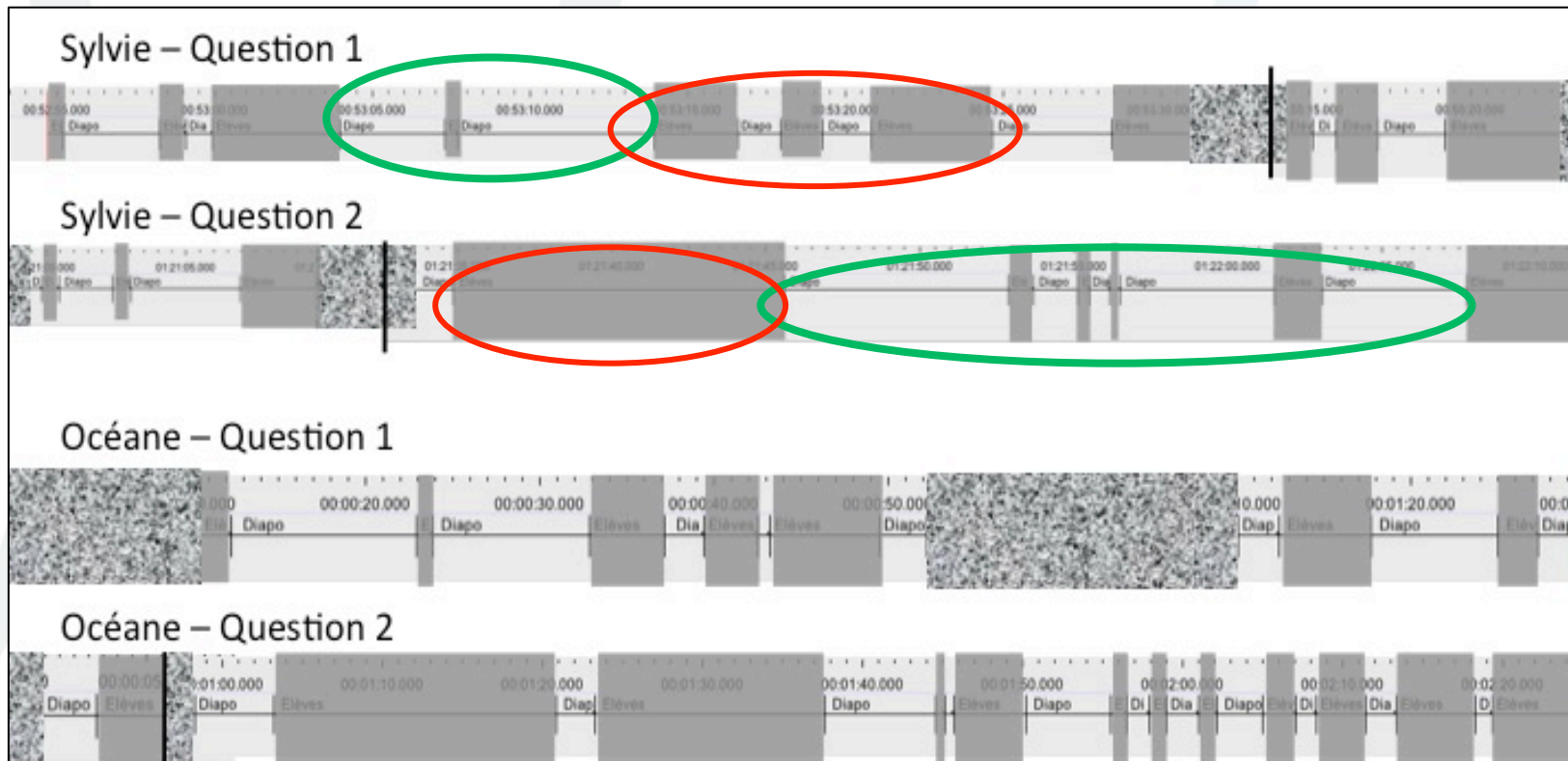
## Classification of the 91 verbal sequences of *mediation*

Type of mediating verbal element	Rewording (32)	Elucidation (23)	Addition (36)
<b>Definition</b>	<p>No new information.</p> <p>Rephrasing the information presented on the slide in the instructor's own words.</p>	<p>Relating two pieces of information from the slide.</p> <p>OR</p> <p>(Interpretative) inferences based on the slide informational content.</p>	<p>Providing new pieces of information that cannot be inferred from the slide.</p> <p>An addition may consist of an example, justification, implication, etc. of a fact mentioned on the slide.</p>
<b>Examples from explanations about Q2</b> (appendix 3)	<i>so the way they get their water is they have to buy it from er: tank trucks and street vendors\</i>	<i>the reason that it's more expensive is because they don't have access to: like a network of: of plumbing\ and su- and supplies like that\</i>	<i>like in kenosha it doesn't matter if you're richer or if you don't have as much money you guys are all paying the same for your water\</i>
<b>Initial text provided visually</b> (slide reproduced in appendix 4)	<i>people living in shantytowns in the developing world buy their drinking water at the highest price in the world, from tank trucks and street vendors</i>	<i>in cities, there can be very sharp differences in prices depending on whether one is connected to local water networks or not</i>	<i>in general, once one is connected to local water networks, household users all pay the same price, regardless of whether they are rich or poor</i>

## 4. RESULTS



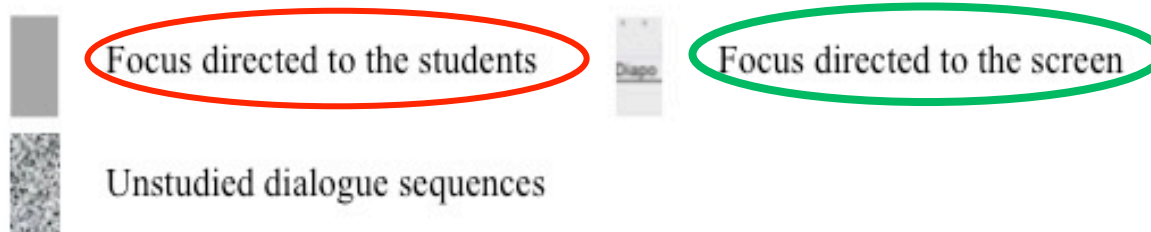
## Pattern of attention focus alternation : screen / students



Ex from the  
French data

**Figure 2. Attention focus during monologue explanation - French instructors (ELAN screen captures)\*.**

\*Color codes for figures 1 and 2:



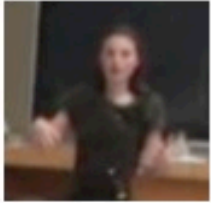

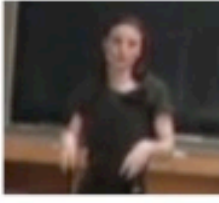
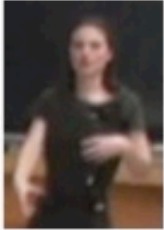
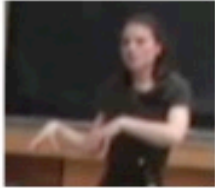


## Case 1: Use of representational gestures facing the students





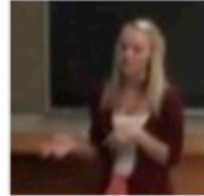



# Case 1: Use of representational gestures facing the students

Speech	Representational gesture	Picture
1 <i>Because <b>most of our: er: coffee beans</b></i>	Two hands : - parallel in conduit metaphor > <b>quite a big thing/quantity</b> - palms to herself > <b>hers</b>	
2 <i><b>and everything</b></i>	Keeping the parallel hands of the conduit metaphor > <b>thing /quantity</b> + abstract pointing on the right > <b>another, different</b>	
3 <i><b>are not grown in the us\ so then</b></i>	Hands pointing down, with beats on 'not', 'grown' and 'us' > <b>ground, land, here</b>	
4 <i><b>the production</b></i> <i>em: as far as we would see it</i>	Polysign mainly using the right hand - claw shape: <b>to take</b> - moving up: <b>to grow</b> - cyclic trajectory: <b>process</b> > <b>to cultivate, to harvest</b>	
5 <i><b>here</b></i>	Two hands pointing down > <b>this land, the usa</b> + on the right > getting closer to the slide	

## Case 2: Establishing bridges between a variety of semiotic modes

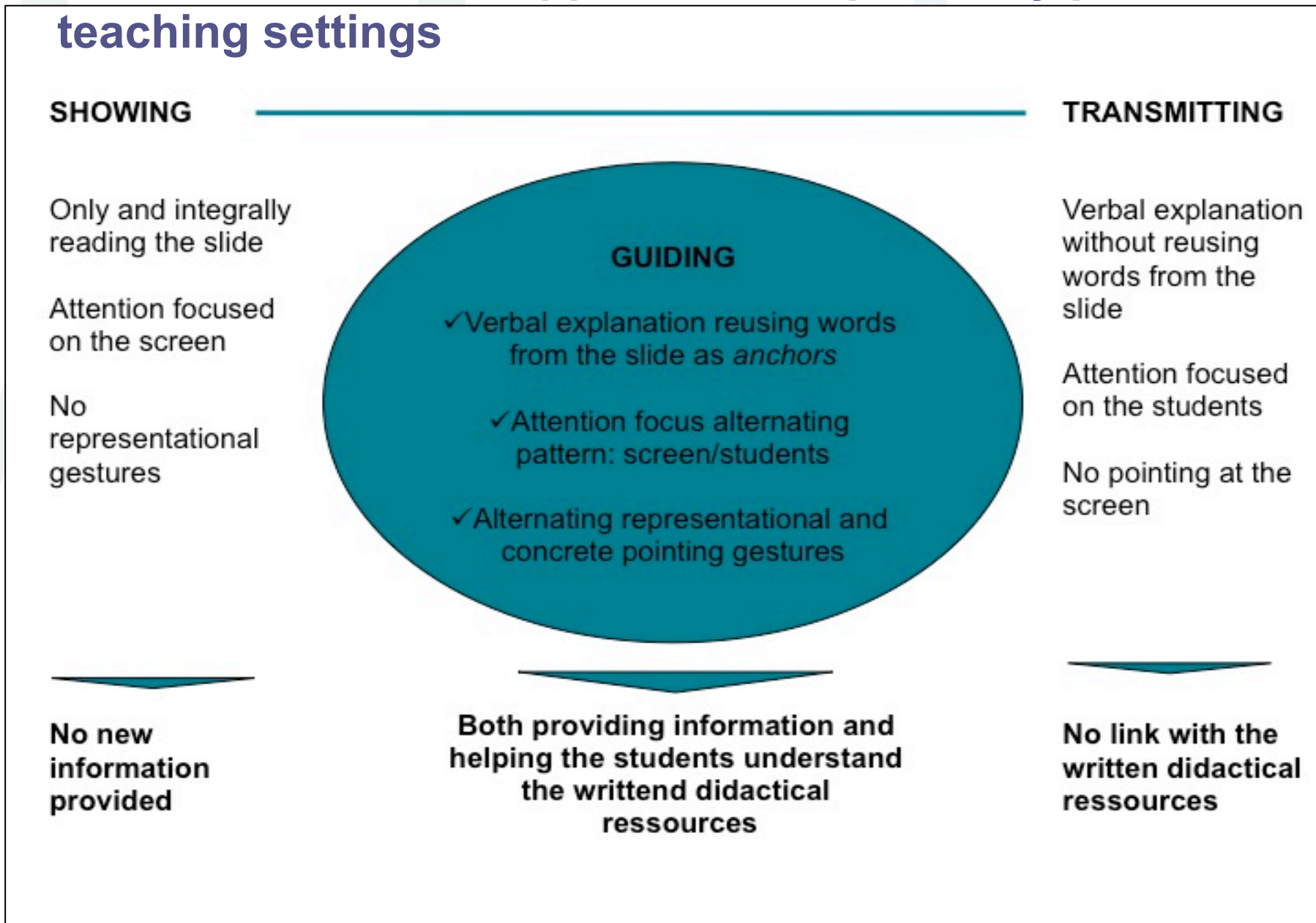


## Case 2: Establishing bridges between a variety of semiotic modes

Speech	Focus	Gesture	Picture
1 <i>so that</i>		Representational, two-hand: abstract pointing to the right > <b>causality</b>	
2 <i>might be why</i>	Students	Hands' trajectory transformed into a concrete pointing at the slide	
3 <i>ours is</i>		Concrete pointing: right hand index finger pointing at the slide, as referring to a precise point on the screen	
4 <i>lower\</i>	Screen	Representational, right hand: - moving down: <b>smaller</b> - flat line shape: <b>level</b> > <b>low level</b>	

## 5. DISCUSSION

# Model for a multimodal approach to explanatory practice in teaching settings





*Thank you for your attention !*

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## Proportion of gesturing time in explanations

Instructor	Question	Pointing (%)	Representational gestures (%)
Cathy	Q1	38,9	27
	Q2	29,7	30,1
Marlene	Q1	14,9	27,9
	Q2	9,8	<b>45,8</b>
Iris	Q1	<b>0</b>	28,4
	Q2	1,8	<b>12,9</b>
Sylvie	Q1	22,3	25,3
	Q2	<b>57,6</b>	19,6
Océane	Q1	42,3	22,4
	Q2	30,6	43,8