

## Chapter 9:

From collaborative learning  
to classroom orchestration

# How do people learn ?

- by exploration, trial and error
- by incremental mastery
- by verbal elaboration

*Constructivism*

*mastery learning*

*socio-constructivism*

collaboration as a **method**

Cognition is  
**individual**

Cognition is  
**social**

collaboration as a **skill**

If you were a school teacher, would you ask students to work in teams? Pick what you might decide and why.

- [2, -2] 'Yes, it might force them to deepen the contents of my lecture'
- [2, -2] 'Yes, even if they won't necessarily learn more, they might at least learn to work together'
- [2, -2] 'No, they can learn to work in teams in many activities outside school'
- [-2, 2] 'No, teamwork takes too much time; I have to move faster in the curriculum.'

If you would decide anyway to make teams, which size of the teams would you choose?

- [-1, -1] 'Teams of 3, because the third can kind of arbitrate the disagreements between the two other ones the team would work better'.
- [2, -2] 'Teams of 2, because with larger teams, there is often one person that does not contribute much, which is unfair for the two other ones''
- [-2, -2] 'Teams of 5, so that I can detect which students take leadership'
- [3, -2] 'Teams of 10, because that's often the size of the teams they will join later on in the workplace'

Let's say that you finally decide to make teams of 2, what would be the best team composition?

- [1, -2] 'Two students with different viewpoints so that they produce multiple solutions.'
- [2, -2] 'Two students with a different backgrounds, so that they get used to handle diversity'
- [-1, 2] 'Two students with the same level, otherwise the better students will waste time with the weaker one'
- [2, -2] 'Two students with different levels, so that one develops the skills of helping other students.'

If during their teamwork, three students start to argue loudly what would you do?

- [0, 2] 'Ask them to elaborate a list of pros and cons and connect it to what was taught in the last lecture''
- [-3, 2] 'Discuss with them to see if some opinions are scientifically incorrect.'
- [-2, -2] 'Nothing, I will ask them to less loud then I will check who wins the argumentation.'''
- [2, 2] 'Nothing, it may force them to deepen their understanding of the task.'''

$$1 + 1 > 2$$

Is learning in teams  
more effective  
than learning alone ?

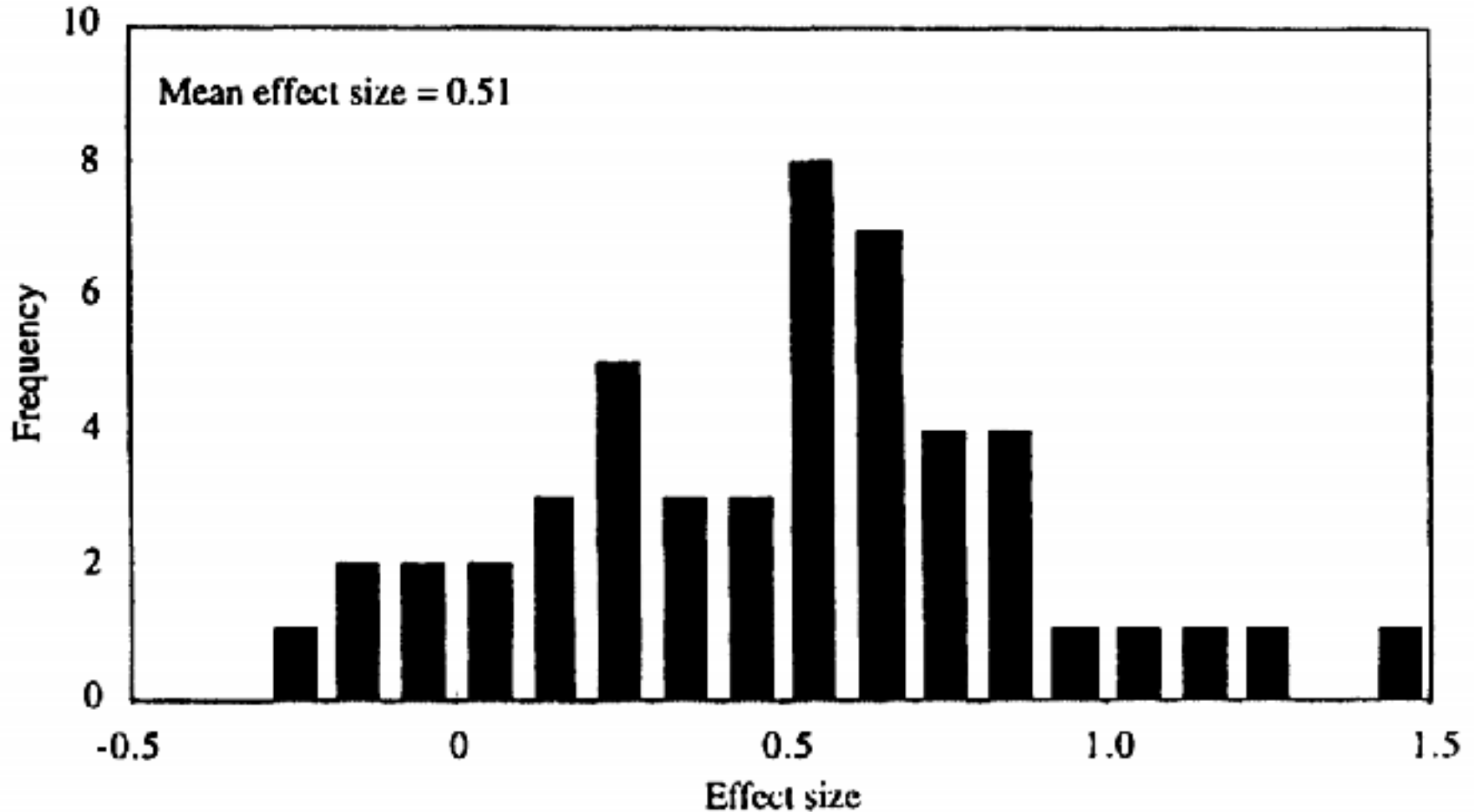
# Research Phase 1

## Is Collaborative Learning Effective ?

	Learning Gains		
Meta-analyses: collaborative versus individual	>	=	<
Slavin, 1983.	<b>26</b>	14	1
Johnson & Johnson, 1989	<b>829</b>	645	109

# Research Phase 1

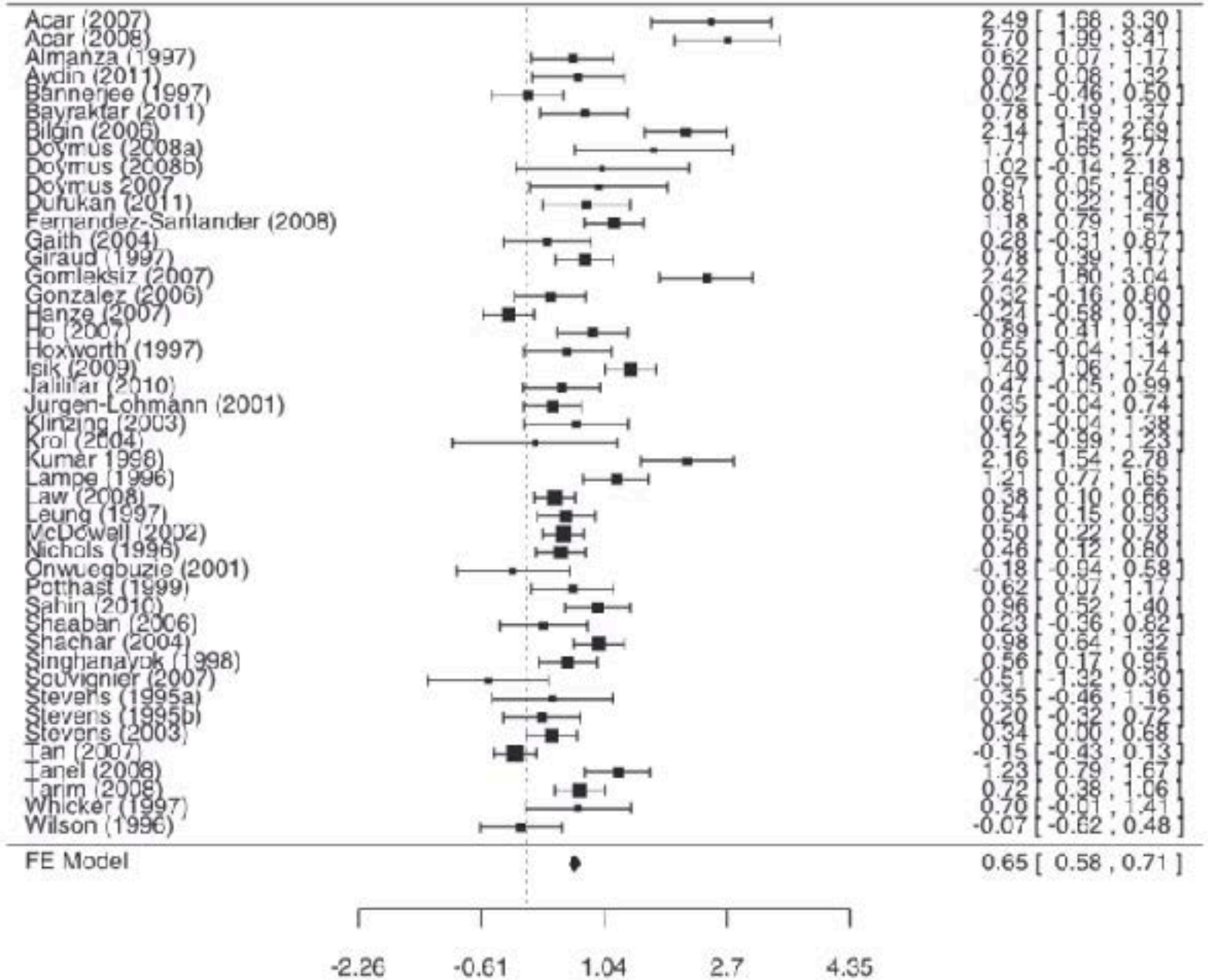
## Is Collaborative Learning Effective ?



Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of educational research*, 69(1), 21-51.

Kyndt, E., Raes, E., Lismont, B., Timmers, F., Cascallar, E., & Dochy, F. (2013). A meta-analysis of the effects of face-to-face cooperative learning. Do recent studies falsify or verify earlier findings?. *Educational research review*, 10, 133-149.

9 ^  
48 ||  
95 v



# Research Phase 1

## Is Collaborative Learning Effective ?

A **decision maker** could conclude that the probability that team learning is effective is high enough to use it.

A **learning scientist** would conclude that team learning is not effective per se, but depends on the **conditions**... see next slide

## Research Phase 2

**When** is collaborative learning effective ?

### Independent Variables

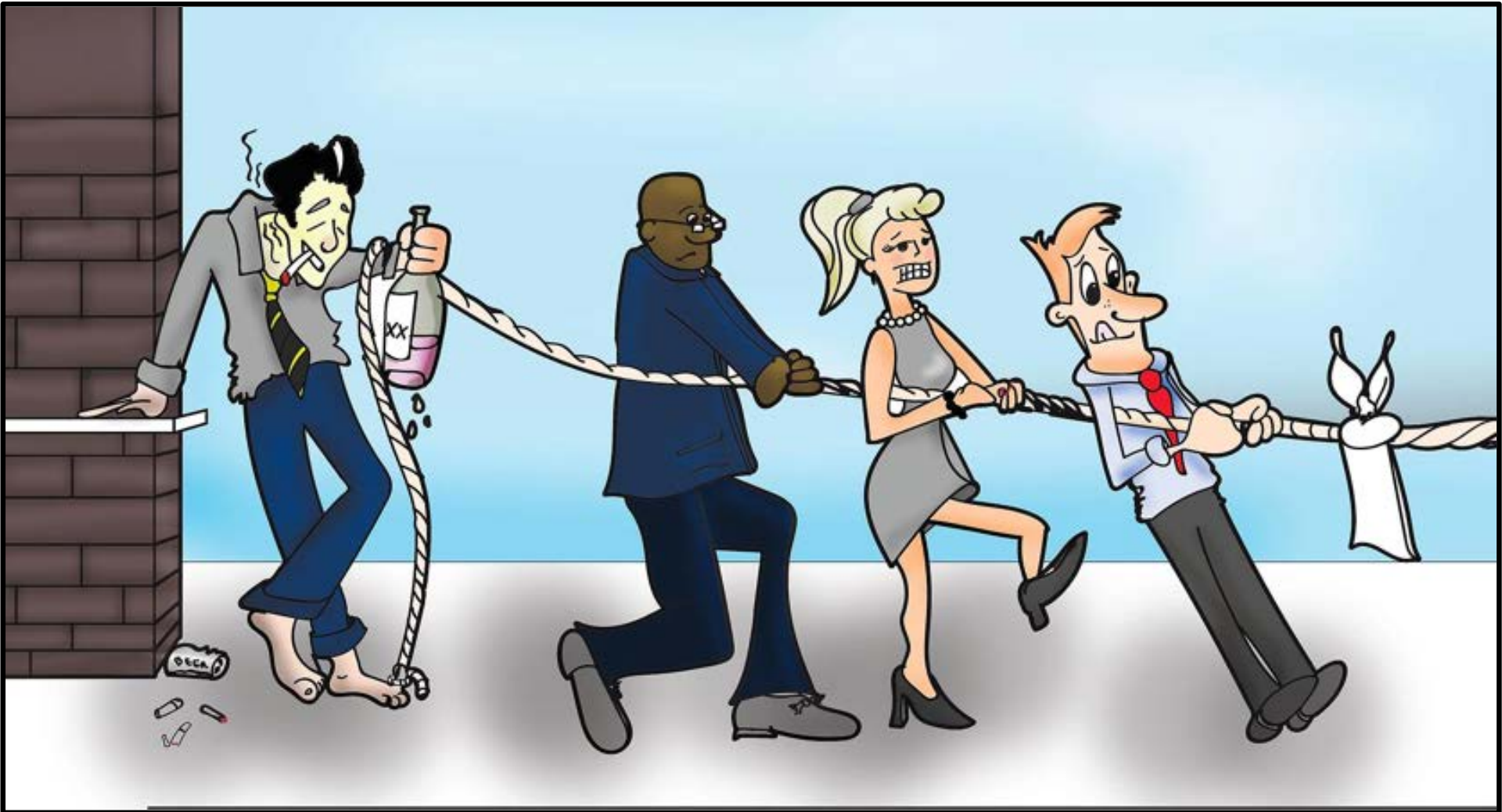


#### Factors:

- **Group** composition: number, level, gender, age, ...
- **Task** features: verbalizable, open, ...
- **Medium**: face-to-face, synchro/not, text/audio/video, ...
- **Context**: school/work

The effects of collaborative depends upon so many variables (plus their interaction effects) that it is impossible to predict that a given teamwork in a specific context will be effective

# Pitfalls in Teamwork



'social loafing', 'free rider effect'

# Pitfalls in Teamwork

- Free-rider / Social Loafing: some teams members let the others do the work
- ...

Meeting at the White House Cabinet Room  
during the Cuban Missile Crisis on October 29, 1962.

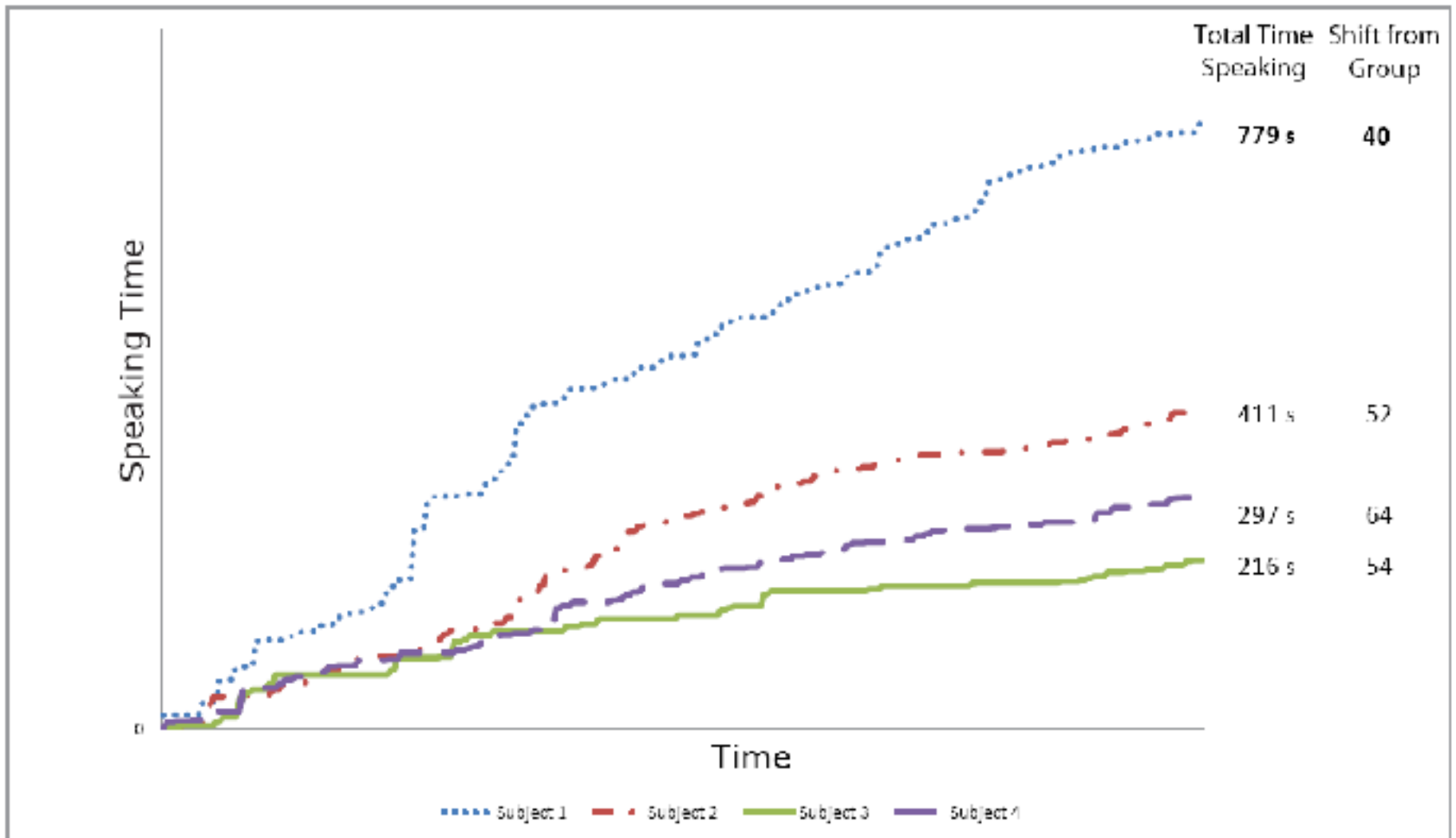


# GroupThink

[https://www.youtube.com/watch?v=glUUmsBb\\_58](https://www.youtube.com/watch?v=glUUmsBb_58)

# Pitfalls in Teamwork

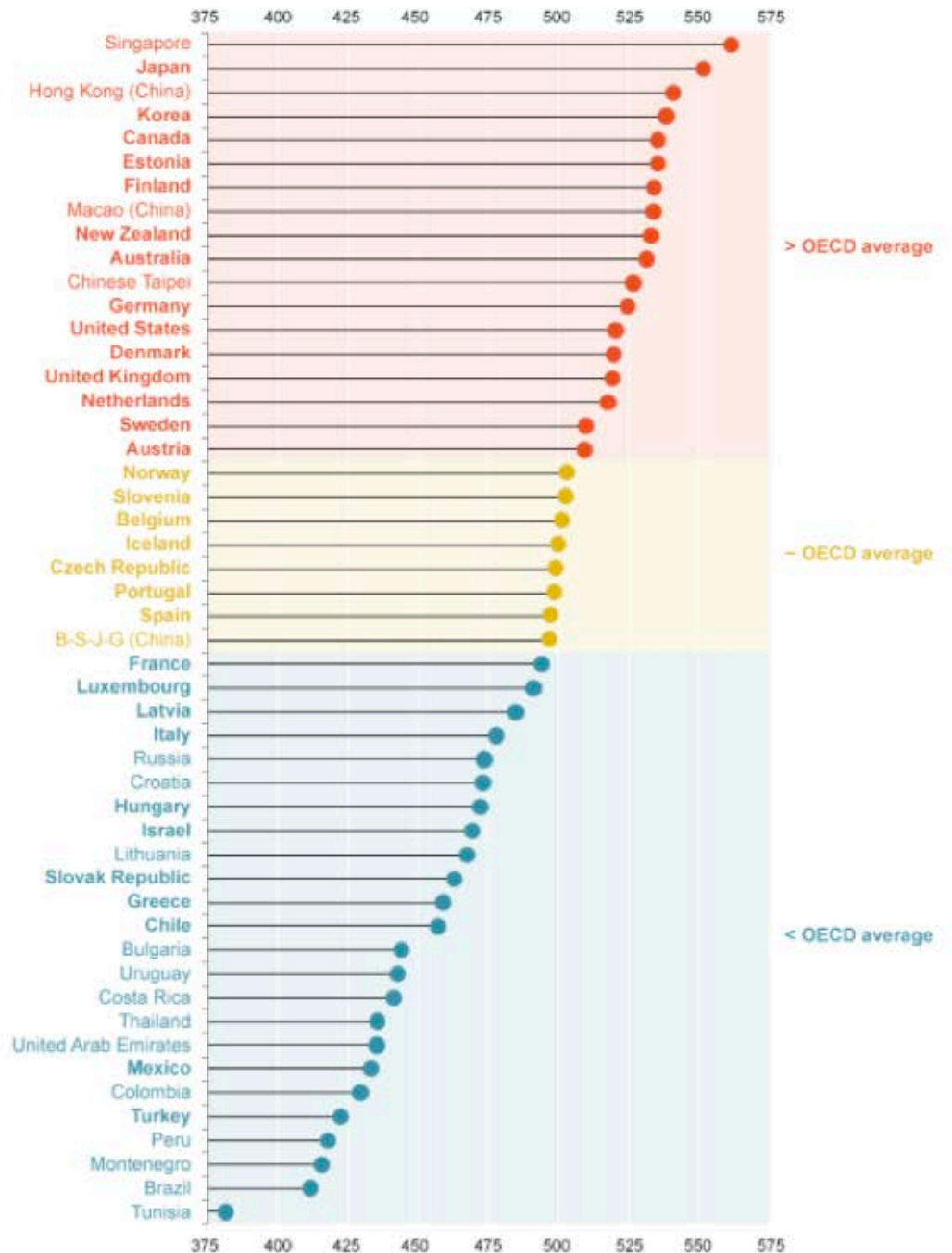
- Free-rider / Social Loafing: some teams members let the others do the work
- 'GroupThink': as soon as they agree, learners return the solution to the teacher without checking if it is the optimal solution In education, as soon as they agree, learners return the solution to the teacher without checking if it is the best one
- In education, consensus to satisfy the teacher
- ....



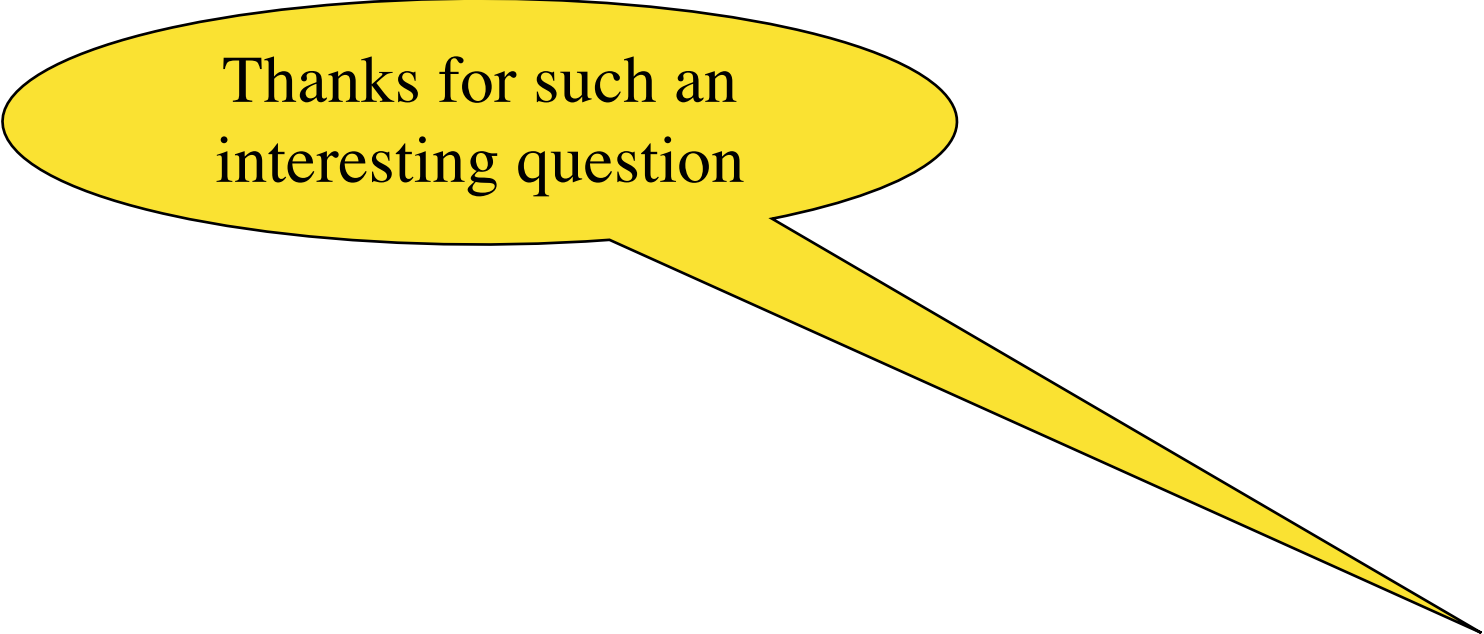
Domination / Disengagement

# Pitfalls in Teamwork

- Free-rider / Social Loafing: some teams members let the others do the work
- 'GroupThink': as soon as they agree, learners return the solution to the teacher without checking if it is the optimal solution In education, as soon as they agree, learners return the solution to the teacher without checking if it is the best one
- In education, consensus to satisfy the teacher
- Domination: some team members dominate verbal interactions; contributions from some members are rejected or not taken into consideration
- ~~Misunderstandings~~
- Emotional (vs epistemic) conflict: « your suggestion is so stupid ! »
- Lack of alignment on goals or commitment
- Lack of « collaboration skills » (one of the 'transversal skills ')



# Apprendre à collaborer ?



Thanks for such an  
interesting question

## Research Phase 3

Which **interactions** make collaborative learning effective ?

1. Elaborated **explanations**

# The (self-)explanation effect

A ball with mass 10kg on the desk is shooting at initial velocity of 10m/s. Calculate the velocity of the ball when it hits the ground.

Solution

When the ball leave from the desk, the ball is forced by weight force only. The object will keep constant velocity motion in X direction and constant acceleration motion in Y direction.

1) flight time t

$$h = \frac{1}{2} \times g \times t^2 \quad \longrightarrow \quad t = \sqrt{\frac{2h}{g}} = 2s$$

2) velocity in X direction

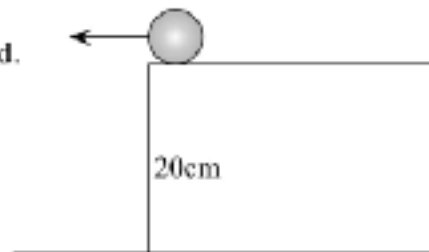
$$v_x = v_{0x} = 10m/s$$

3) velocity in Y direction

$$v_y = v_{0y} + g \times t = 0 + 10 \times 2 = 20(m/s)$$

4) total velocity

$$v = \sqrt{v_x^2 + v_y^2} = 10\sqrt{5}m/s$$



Explaining aloud a worked out problem

The  
(self-)explanation effect

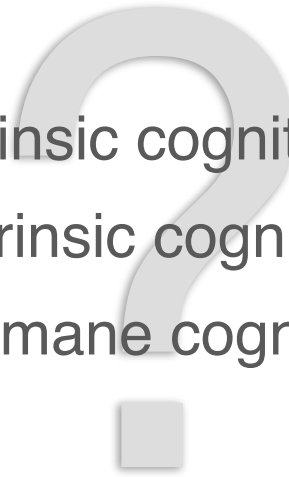
Hedge's Effect size

Moderator	k	$\hat{g}(SE)$	$CI_{\hat{g}}$	$Q_{\hat{g}}(df)$
<i>Type of Self-Explanation</i>				1.11(2)
Prompted	31	.39(.08)	.24 to .54	
Spontaneous	6	.50(.15)	.15 to .85	
Instructional	5	.24(.17)	-.11 to .60	
<i>Instructional Format</i>				0.21(2)
Worked Example	19	.40(.01)	.20 to .58	
Conventional	10	.33(.14)	.05 to .61	
Text	11	.40(.13)	.16 to .65	
<i>Type of Population</i>				1.80(2)
Post-Secondary	26	.38(.05)	.22 to .54	
Secondary	7	.54(.15)	.24 to .84	
Primary	9	.26(.15)	-.03 to .55	
<i>Element Interactivity</i>				0.04(1)
High	39	.38(.07)	.25 to .51	
Low	3	.43(.24)	-.04 to .91	
<i>Field of Study</i>				0.31(3)
Mathematics	22	.36(.03)	.18 to .54	
Engineering/technical	6	.42(.17)	.09 to .75	
Science	9	.45(.15)	.16 to .73	
Other	5	.37(.19)	.00 to .74	
<i>Pacing of Learning</i>				0.00(1)
Limited	8	.51(.13)	.26 to .76	
Self-Paced	25	.50(.08)	.35 to .65	
<i>Feedback</i>				0.03(1)
Yes	9	.37(.16)	.09 to .64	
No	33	.39(.07)	.25 to .54	

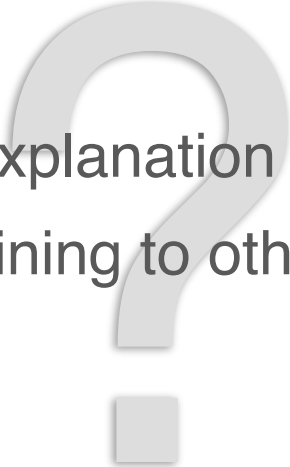
Note. k = number of effect sizes;  $\hat{g}$  = Hedges' effect size; SE = standard error;  $CI_{\hat{g}}$  = 95% confidence interval around the effect size;  $Q_{\hat{g}}$  = variability between the categories of moderators; df = degrees of freedom.

The (self-)explanation increases

- A. the intrinsic cognitive load
- B. the extrinsic cognitive load
- C. the germane cognitive load



Is germane cognitive load higher

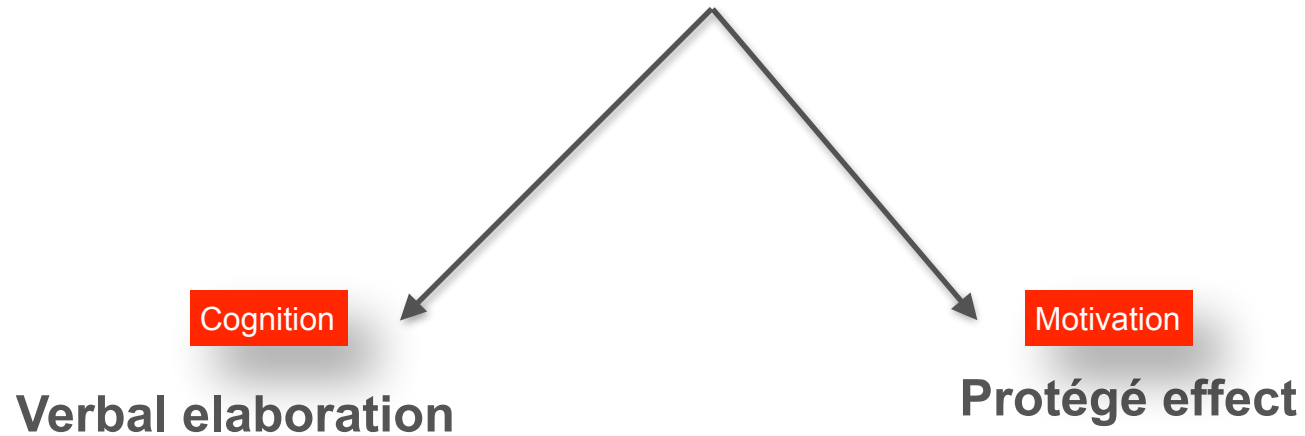
- 
- A. self-explanation
  - B. explaining to other

**Mutual modelling**

# Learning by teaching



# Learning by teaching / tutoring



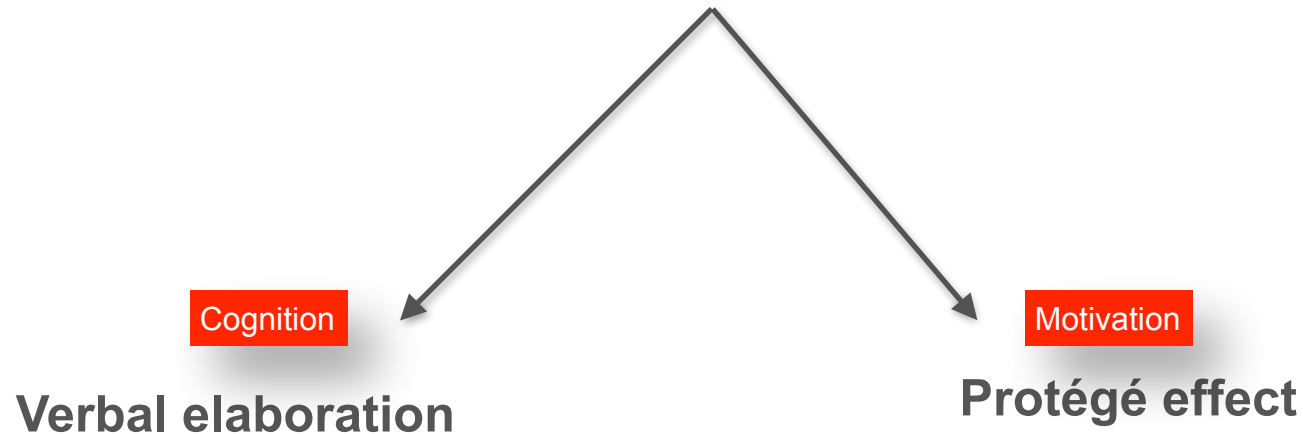
students make greater effort to learn for their TAs than they do for themselves

[https://aalab.stanford.edu/assets/papers/2009/Protege\\_Effect\\_Teachable\\_Agents.pdf](https://aalab.stanford.edu/assets/papers/2009/Protege_Effect_Teachable_Agents.pdf)



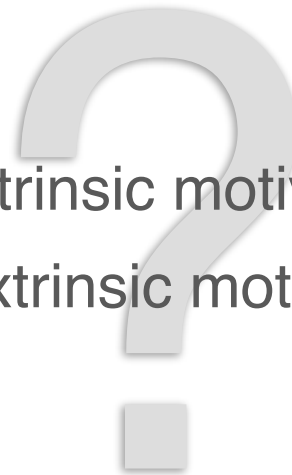
The cowriter project

# Learning by teaching / tutoring



Does it increase:

- A. intrinsic motivation
- B. extrinsic motivation



## Research Phase 3

Which **interactions** make collaborative learning effective ?

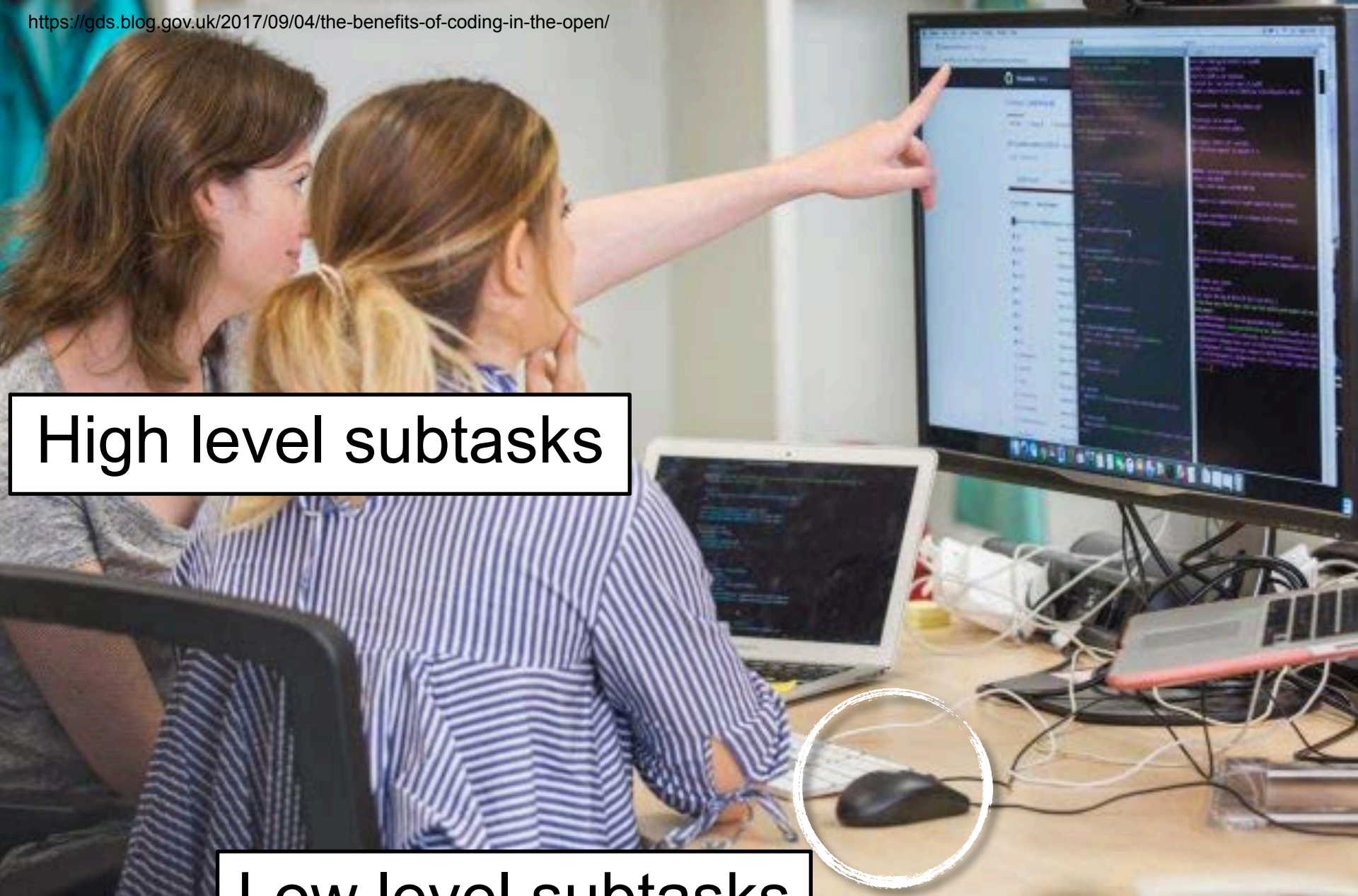
1. Elaborated **explanations**
2. Conflict resolution, **Argumentation** / Négociation

ArgueGraph

## Research Phase 3

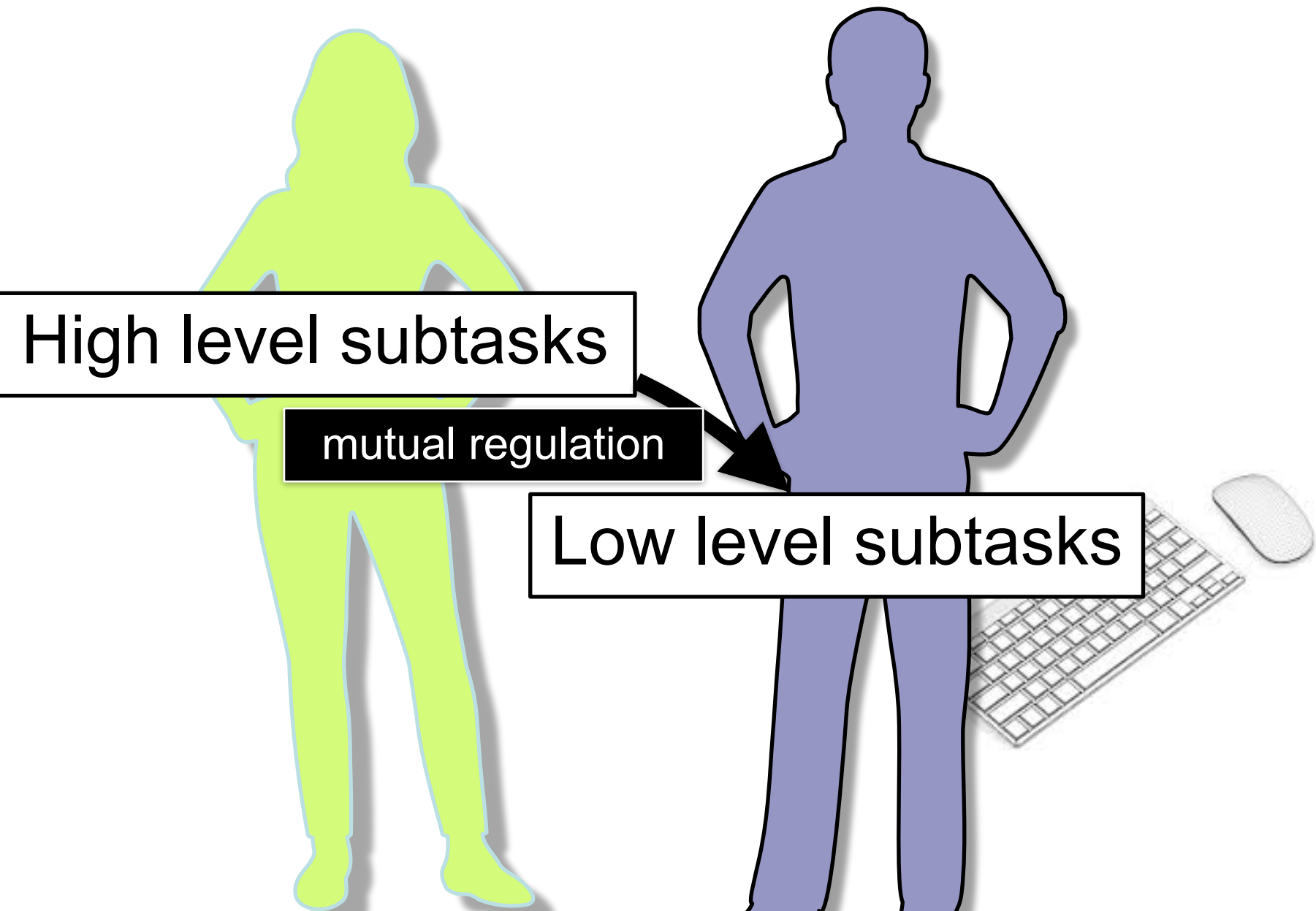
Which **interactions** make collaborative learning effective ?

1. Elaborated **explanations**
2. Conflict resolution, **Argumentation** / Négociation
3. Mutual **Regulation**



High level subtasks

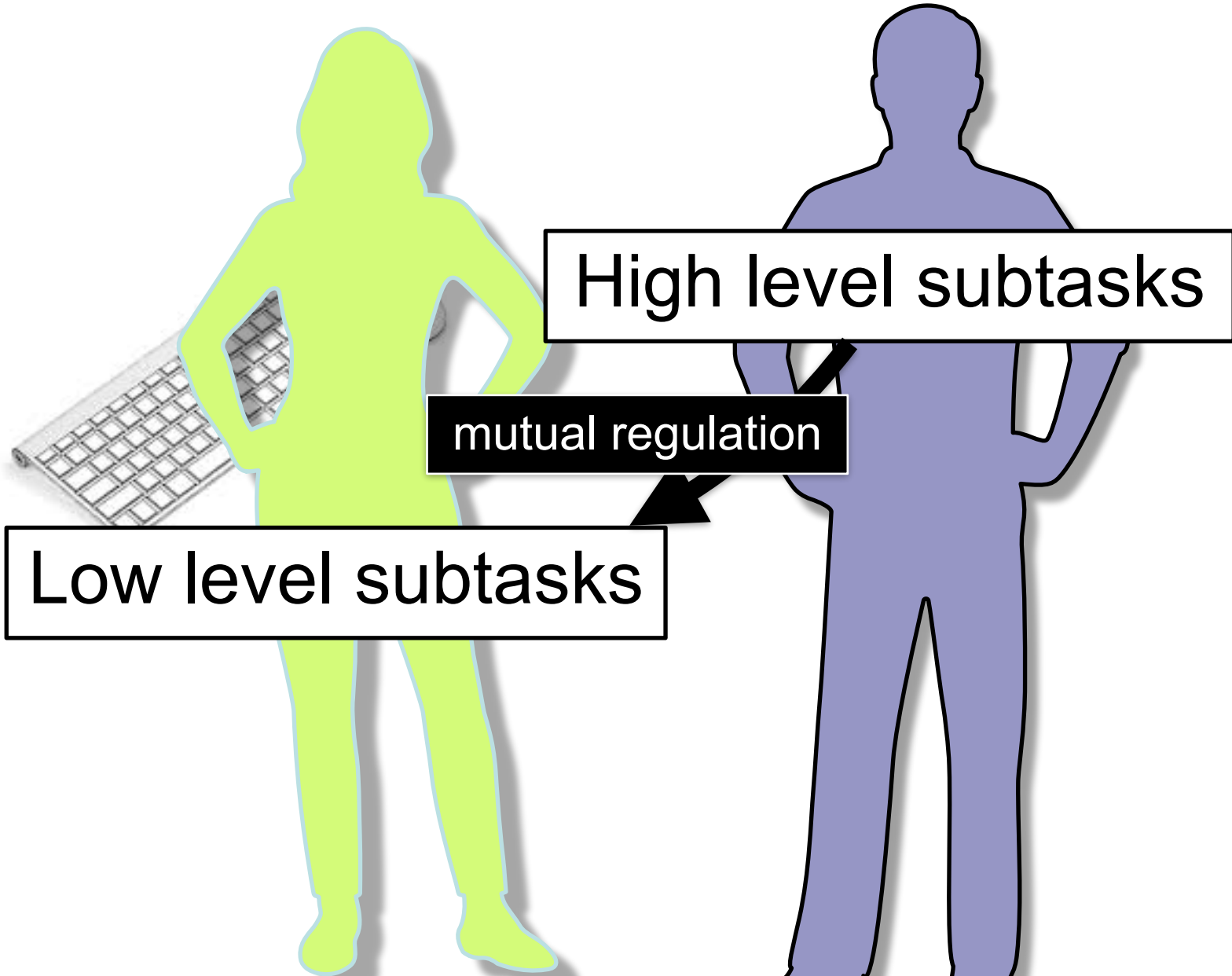
Low level subtasks



High level subtasks

mutual regulation

Low level subtasks



High level subtasks

mutual regulation

Low level subtasks



High level subtasks

self-regulation

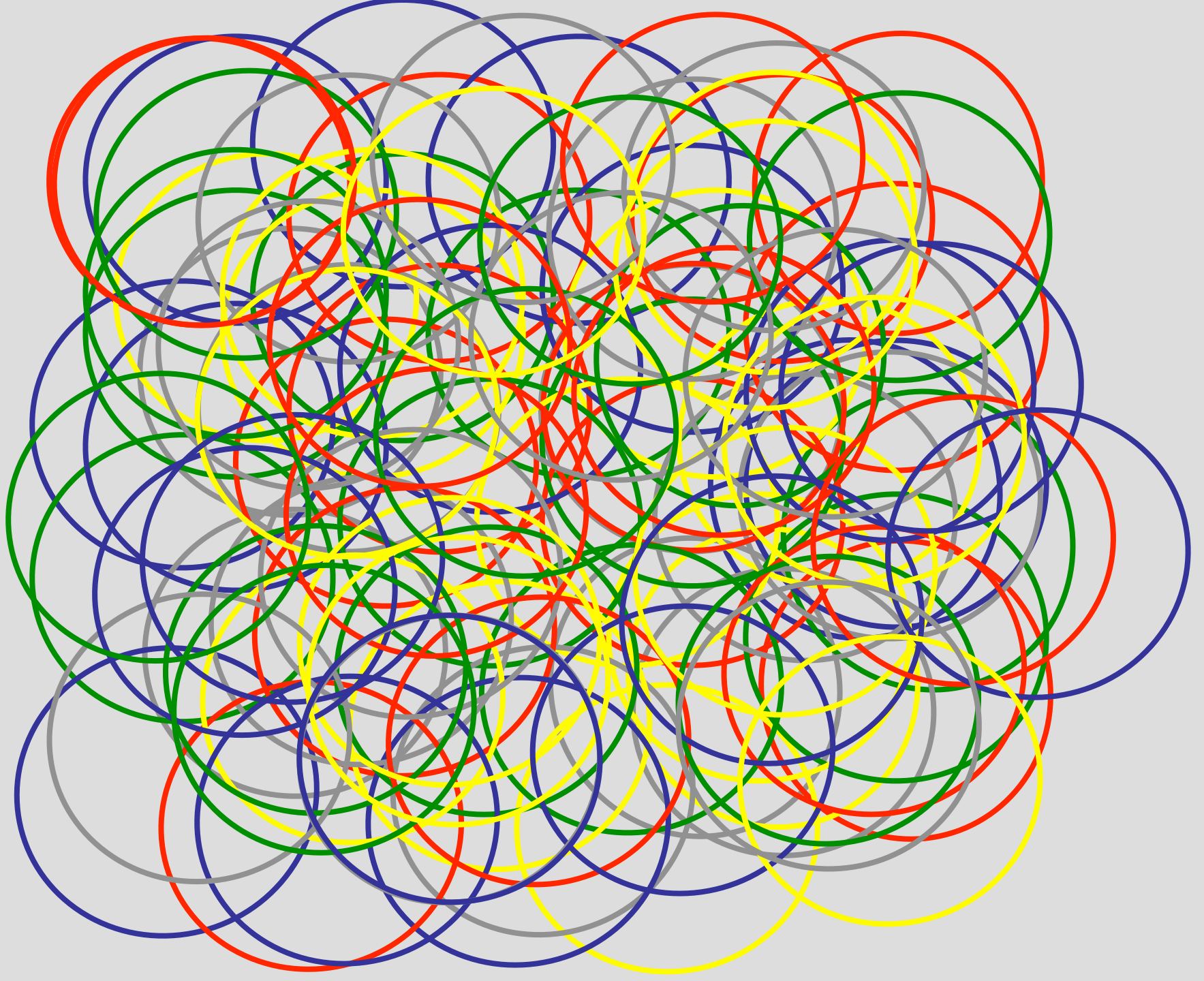
Low level subtasks

Collaborative  $\neq$  Cooperative

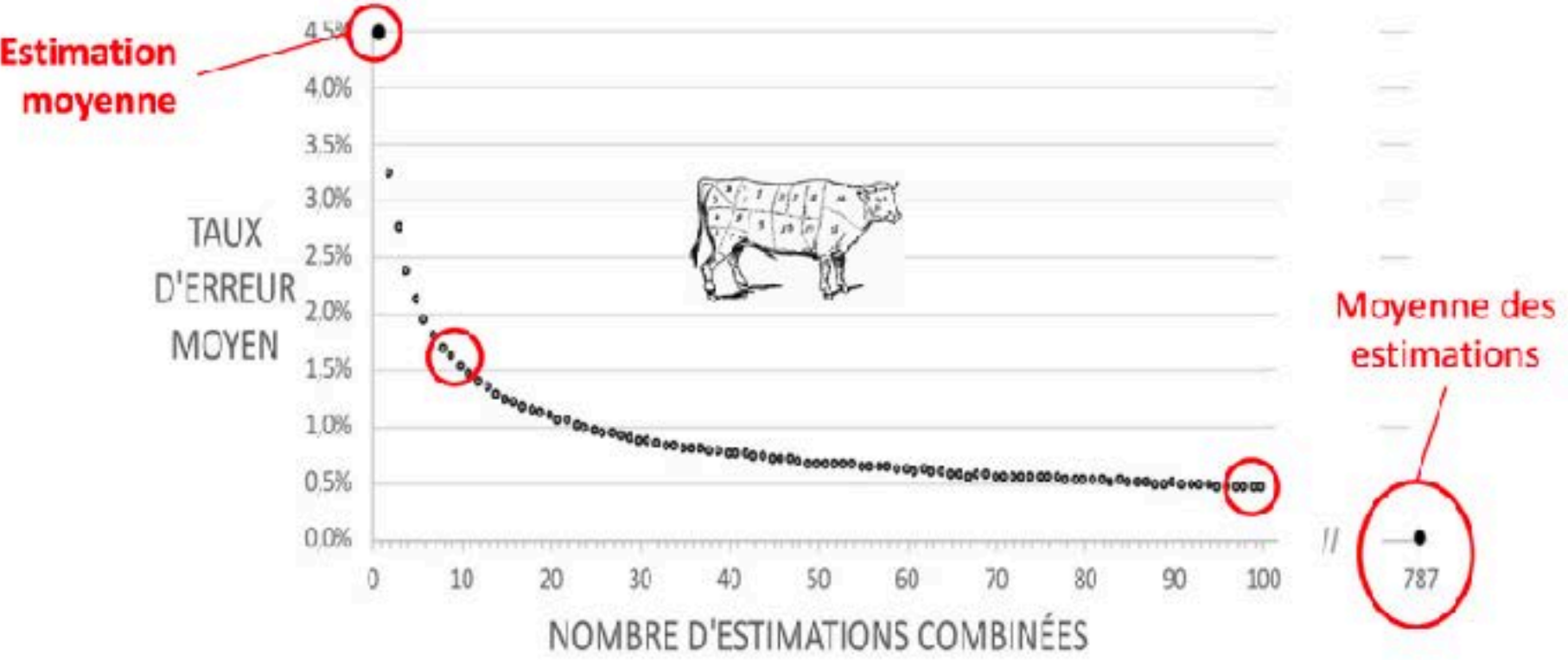
Emerging and instable  
division of labour

Fixed division of labour

Collective ?

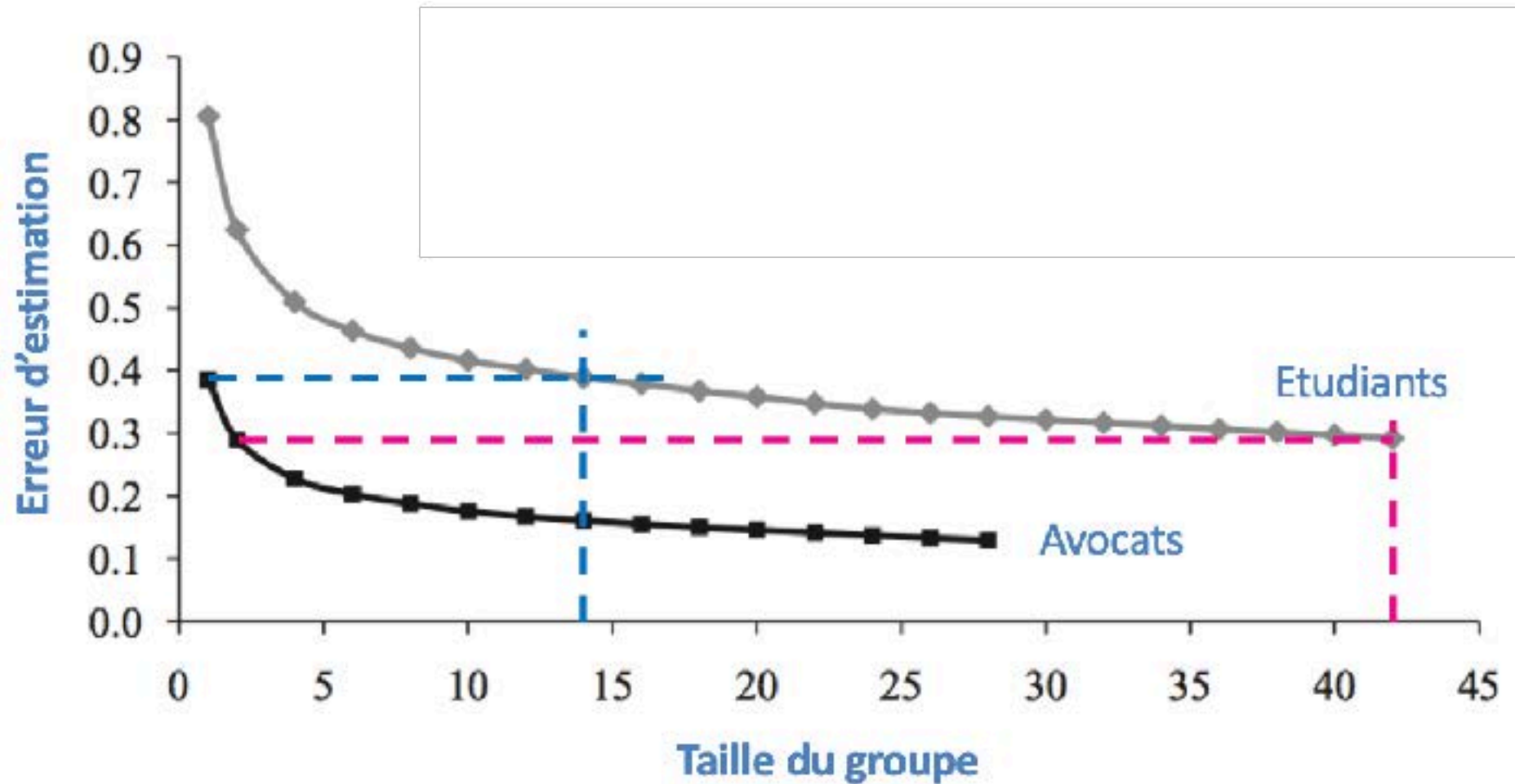


# ERREUR DE JUGEMENT DU POIDS D'UN BOEUF SELON LE NOMBRE D'ESTIMATIONS COMBINÉES



Galton data revisited by Emile Servan-Schreiber

# Collective intelligence ?





Wisdom of crowds ?

Collaborative

Rich interactions

Cooperative

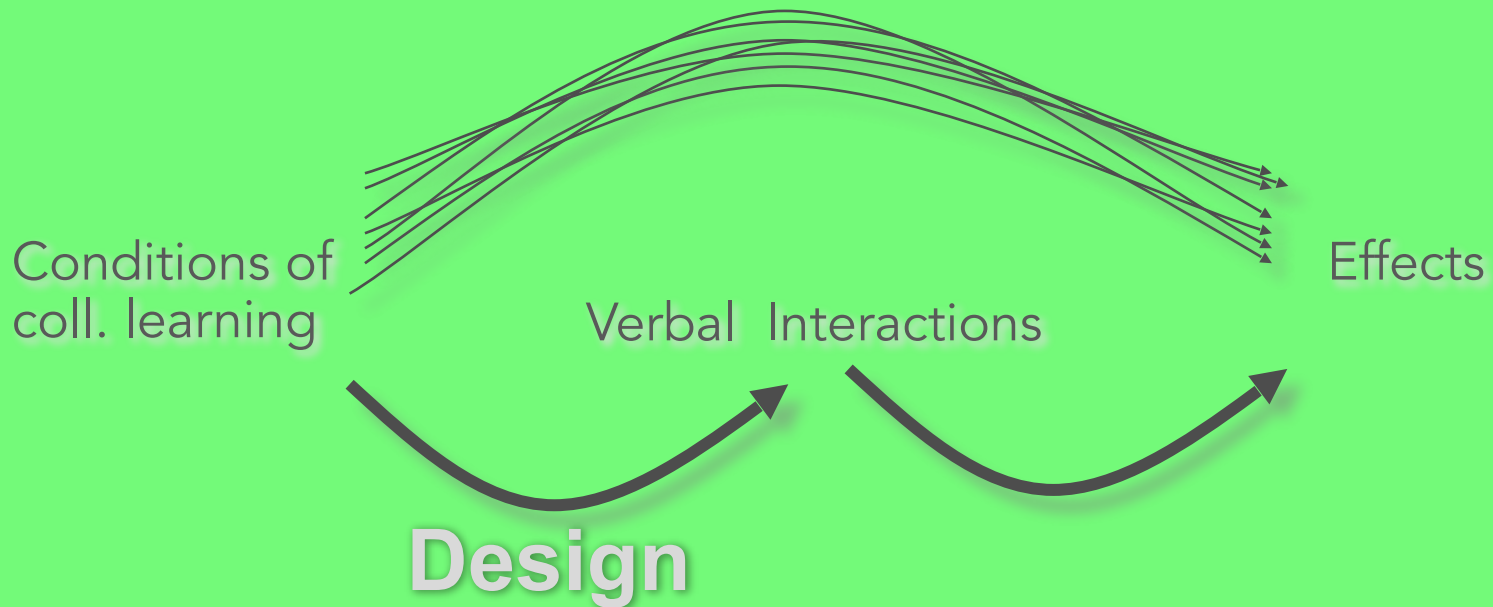
Predefined interactions

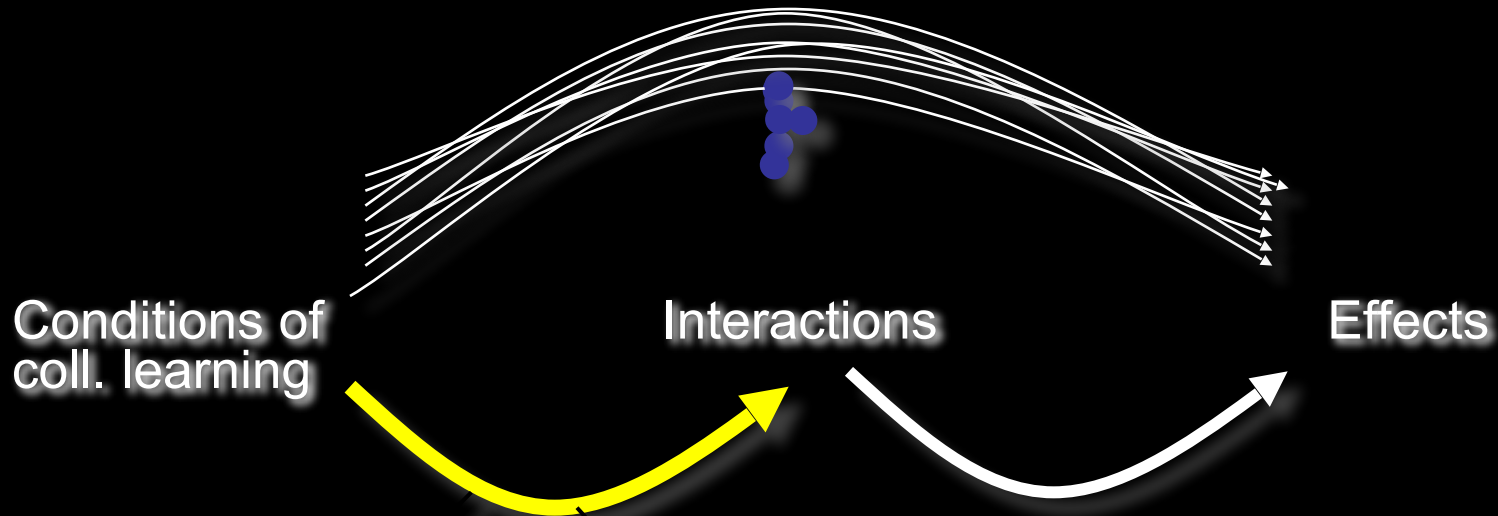
Collective

Basic interactions

## Research Phase 4:

Which **design** increases the probability that teams produce rich verbal **interactions** (that make collaborative learning effective) ?





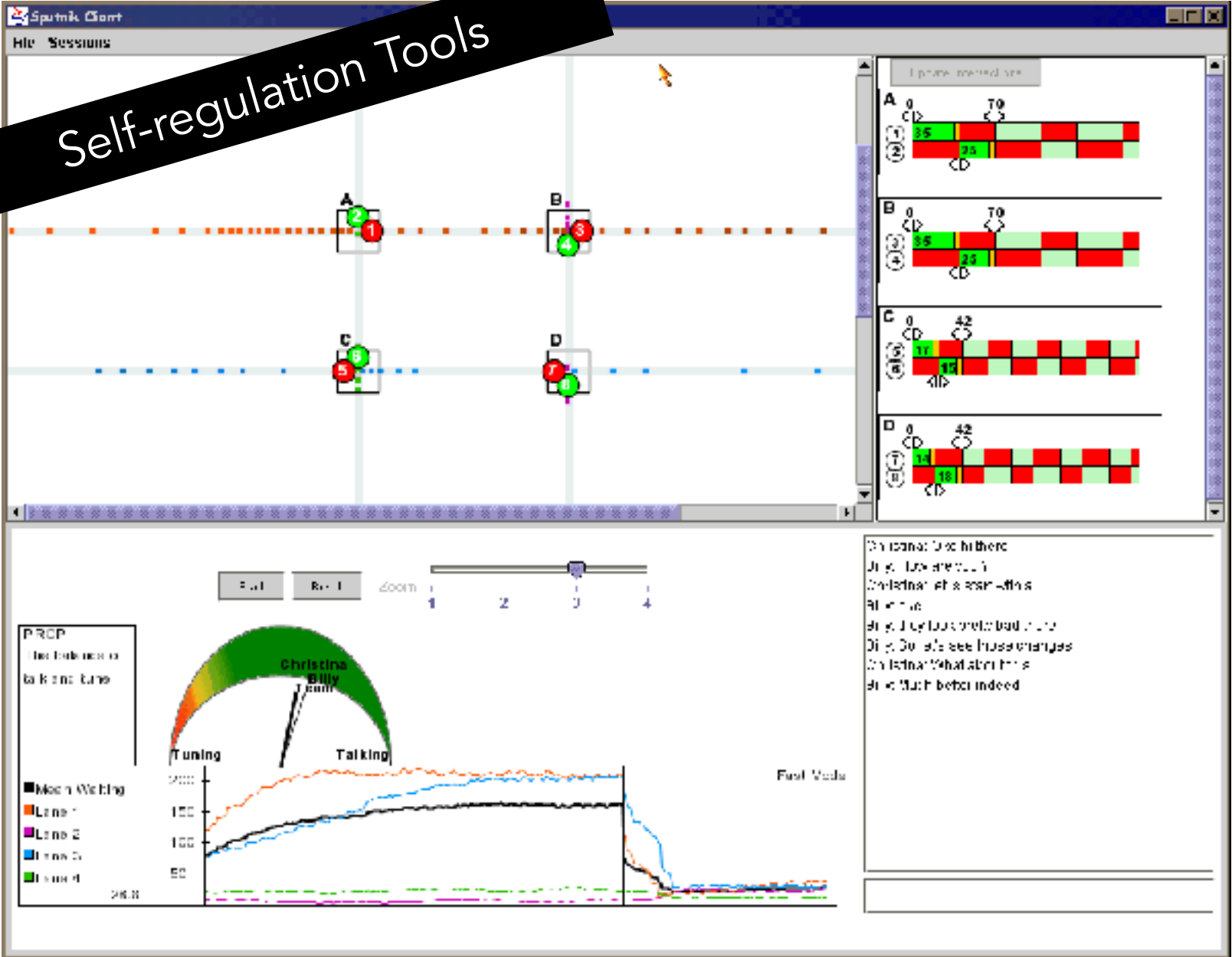
(proactive)

(reactive)

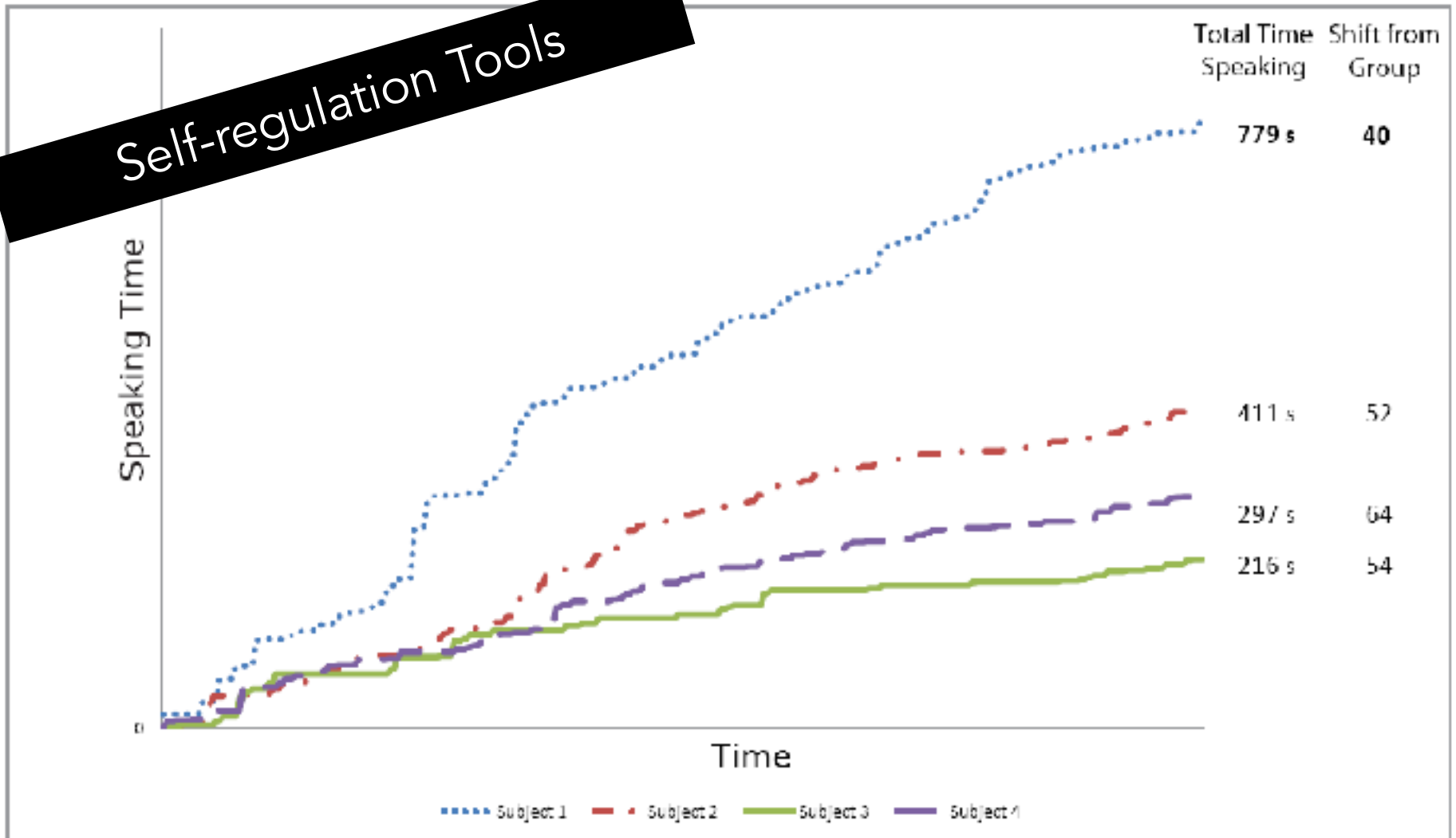
STRUCTURE

(self-) REGULATE

# Self-regulation Tools

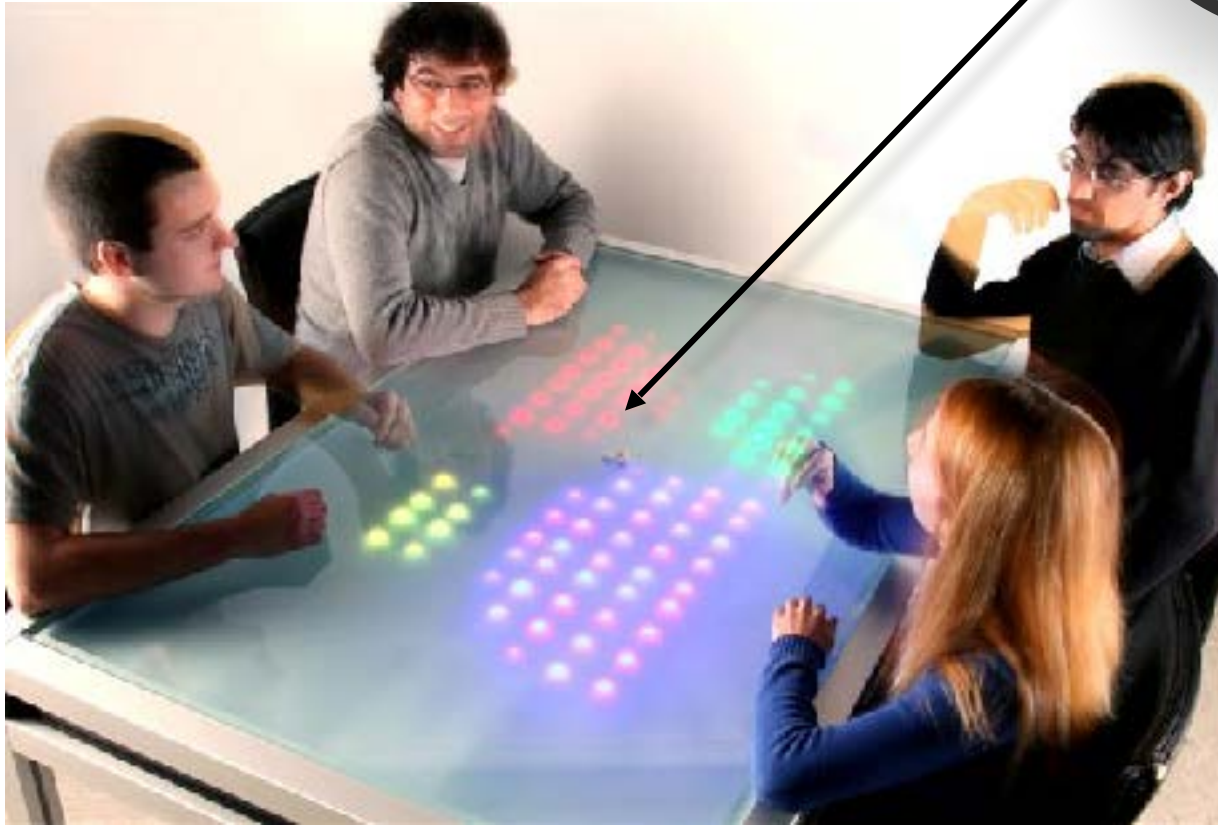


# Self-regulation Tools



Example of domination in teamwork

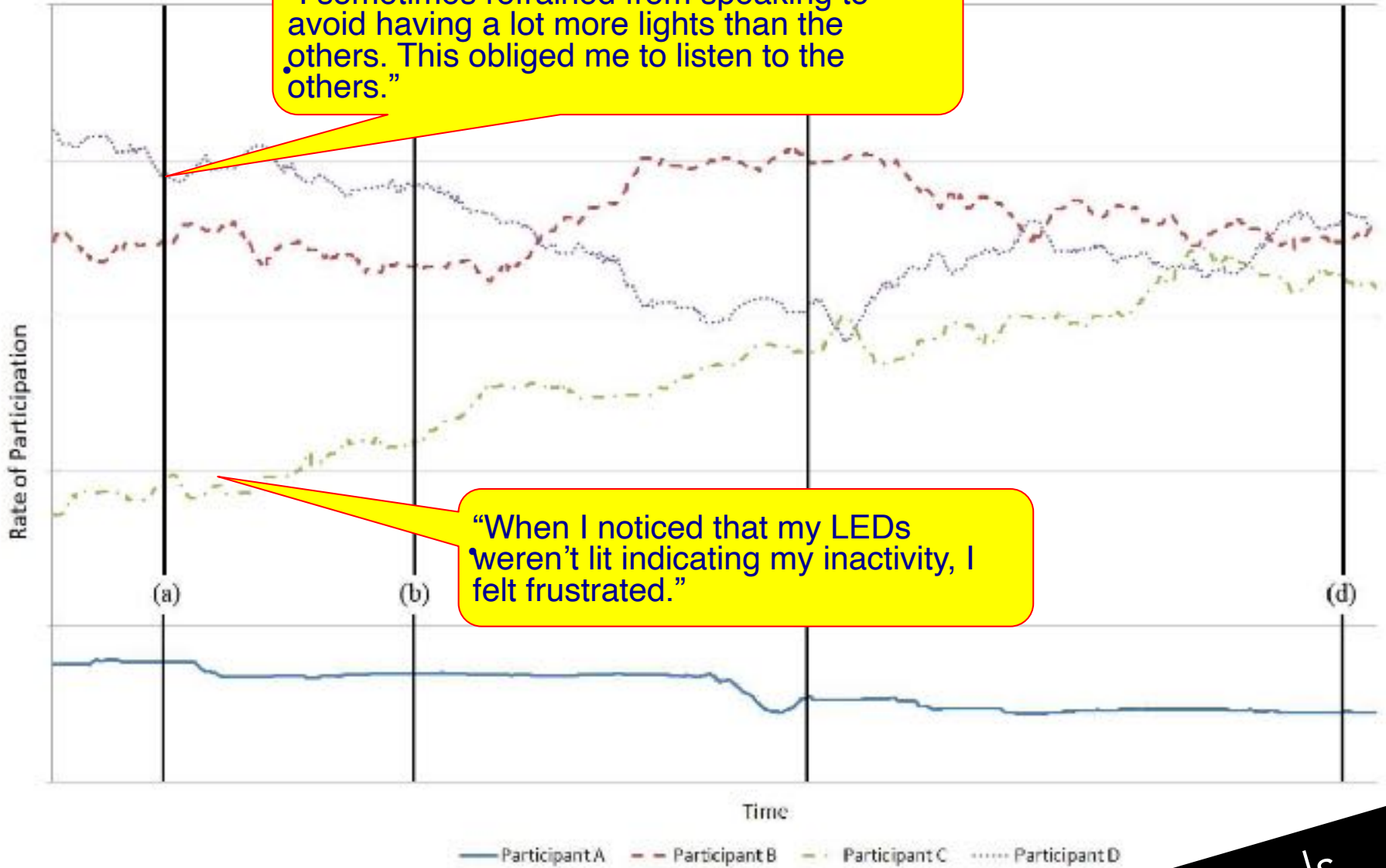
# Self-regulation Tools



## Reflect Table

**Reflect**

“I sometimes refrained from speaking to avoid having a lot more lights than the others. This obliged me to listen to the others.”



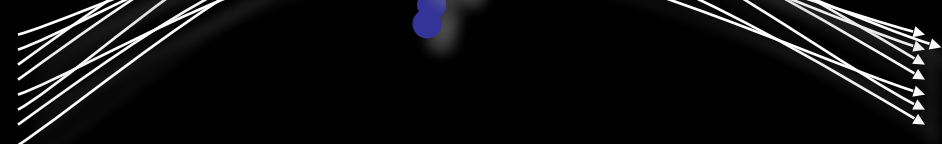
“When I noticed that my LEDs weren't lit indicating my inactivity, I felt frustrated.”

Self-regulation Tools

Conditions of  
coll. learning

Interactions

Effects

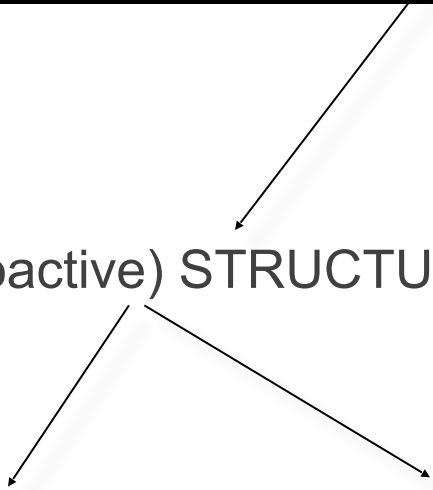


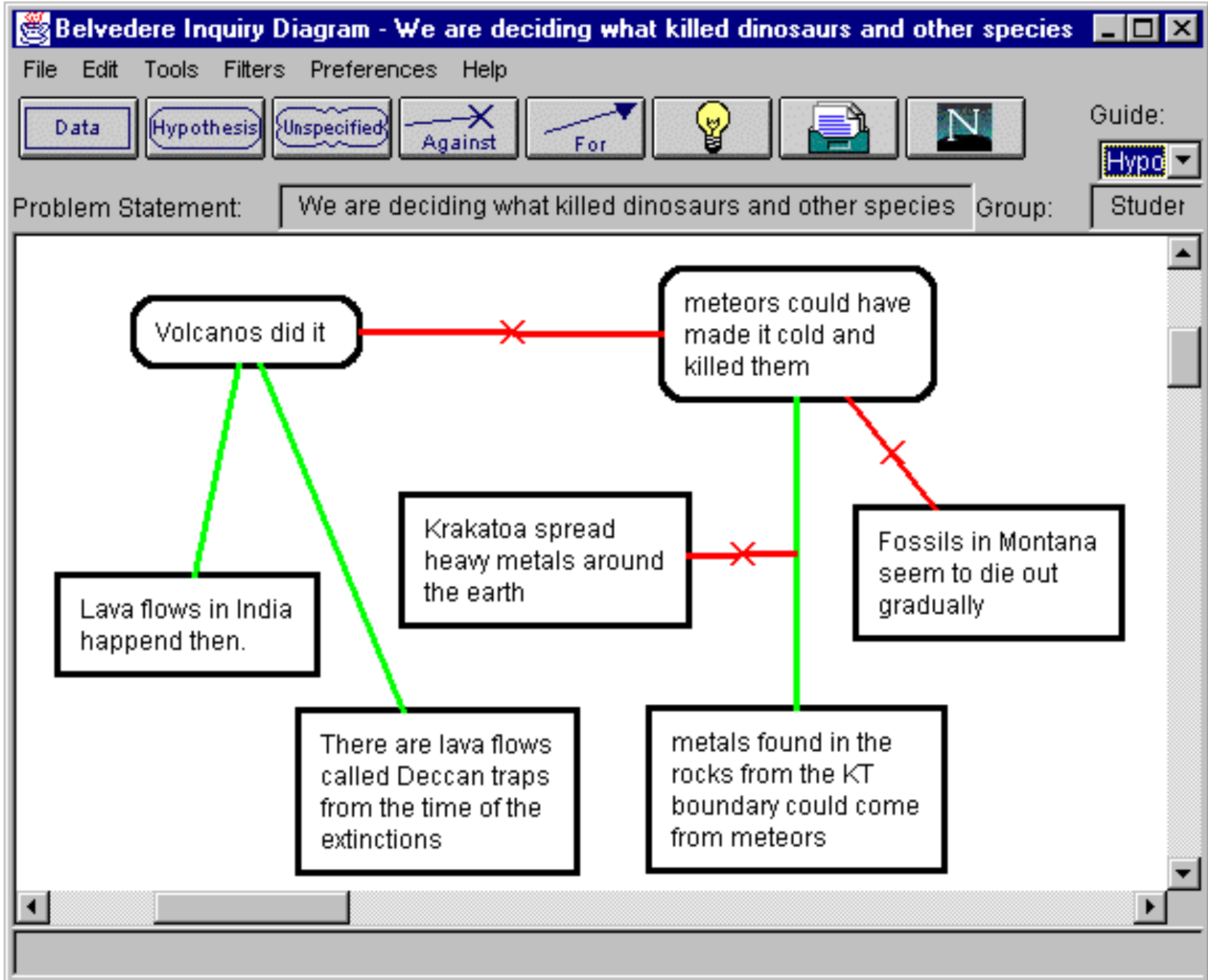
(reactive) REGULATE

(proactive) STRUCTURE

SCRIPTS

**Semi-Structured Interfaces**





Belvedere (Suther et al.)

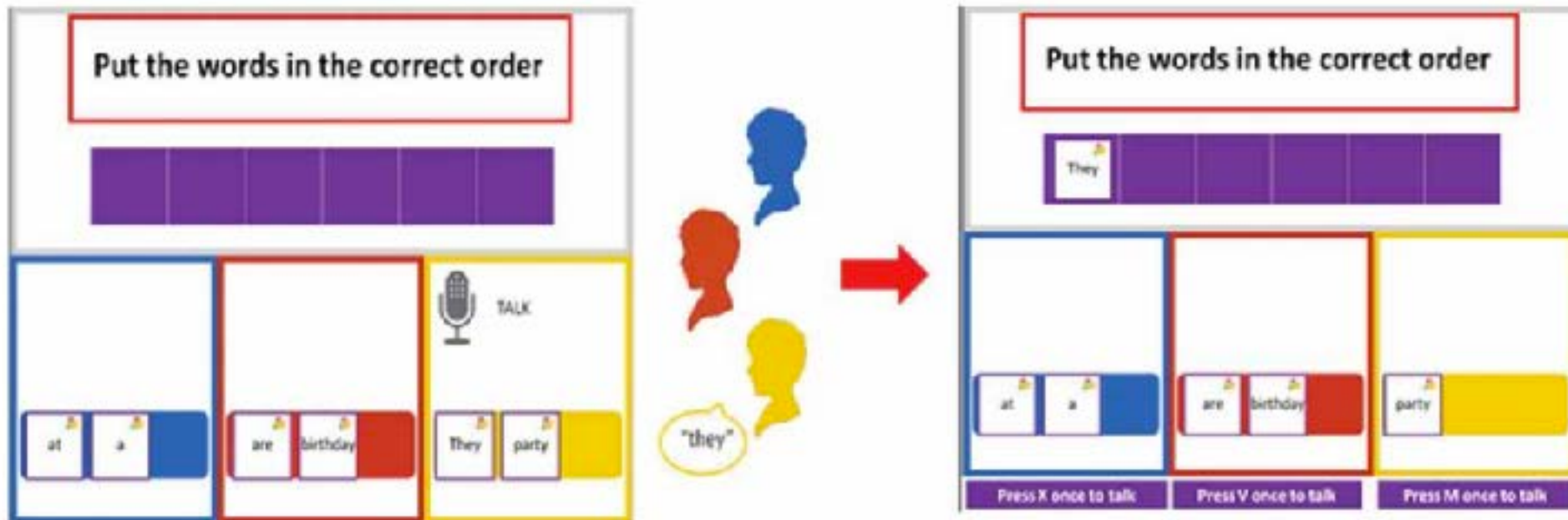
Multi Input Devices: the participation of each learner is “designed” because each mouse only access some screen functions



M. Nussbaum, UC Chile

# Multi Input Devices:

the participation of each learner is "designed" because each mouse only access some screen functions



“Computer-supported collaborative learning” (CSCL)

1990-2000: Technologies **enable** collaboration

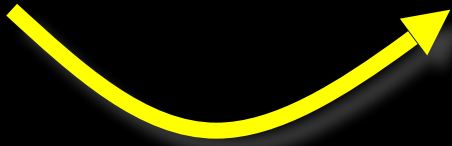
2000-2010: Technologies **shape** collaboration (design)

2010-2020: Technologies that **integrate** collaboration

•Conditions of coll. learning

•Interactions

•Effects



(reactive) REGULATE

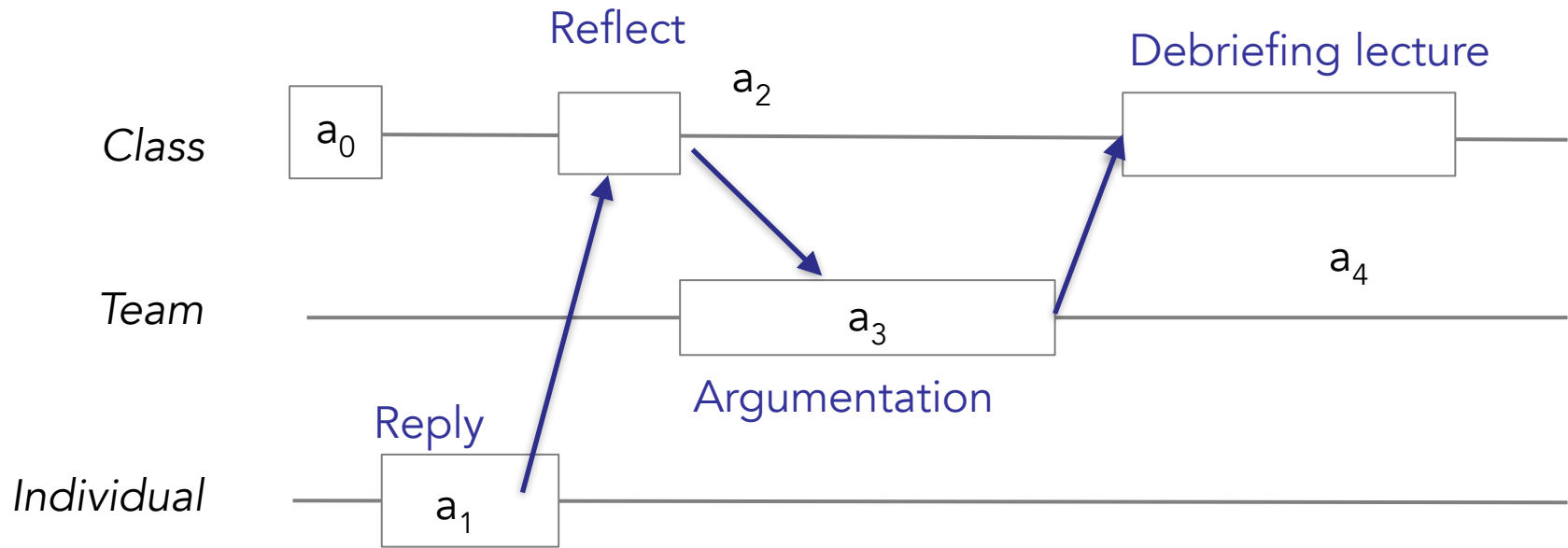
(proactive) STRUCTURE

**SCRIPTS**

Semi-Structured Interfaces

Pedagogical scenario for increasing the probability that interactions X,Y,Z occur in teamwork.

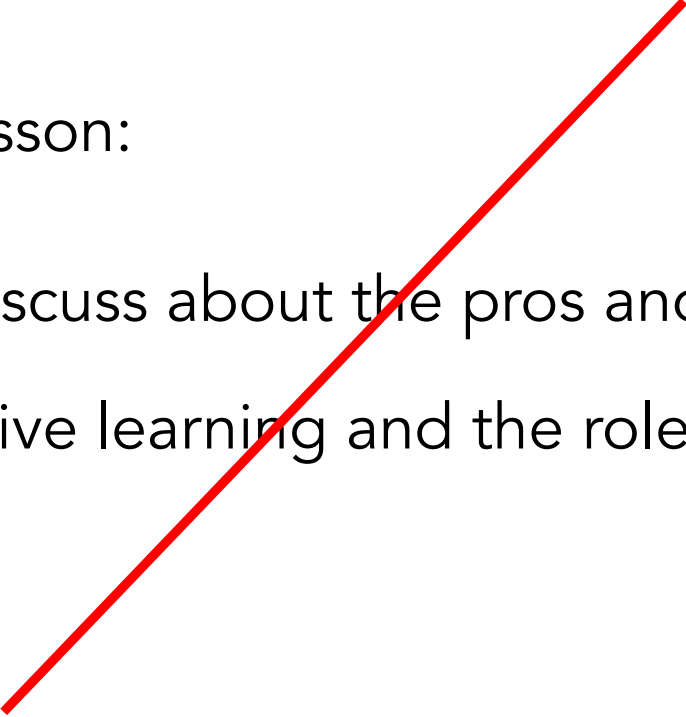
# Orchestration Graph



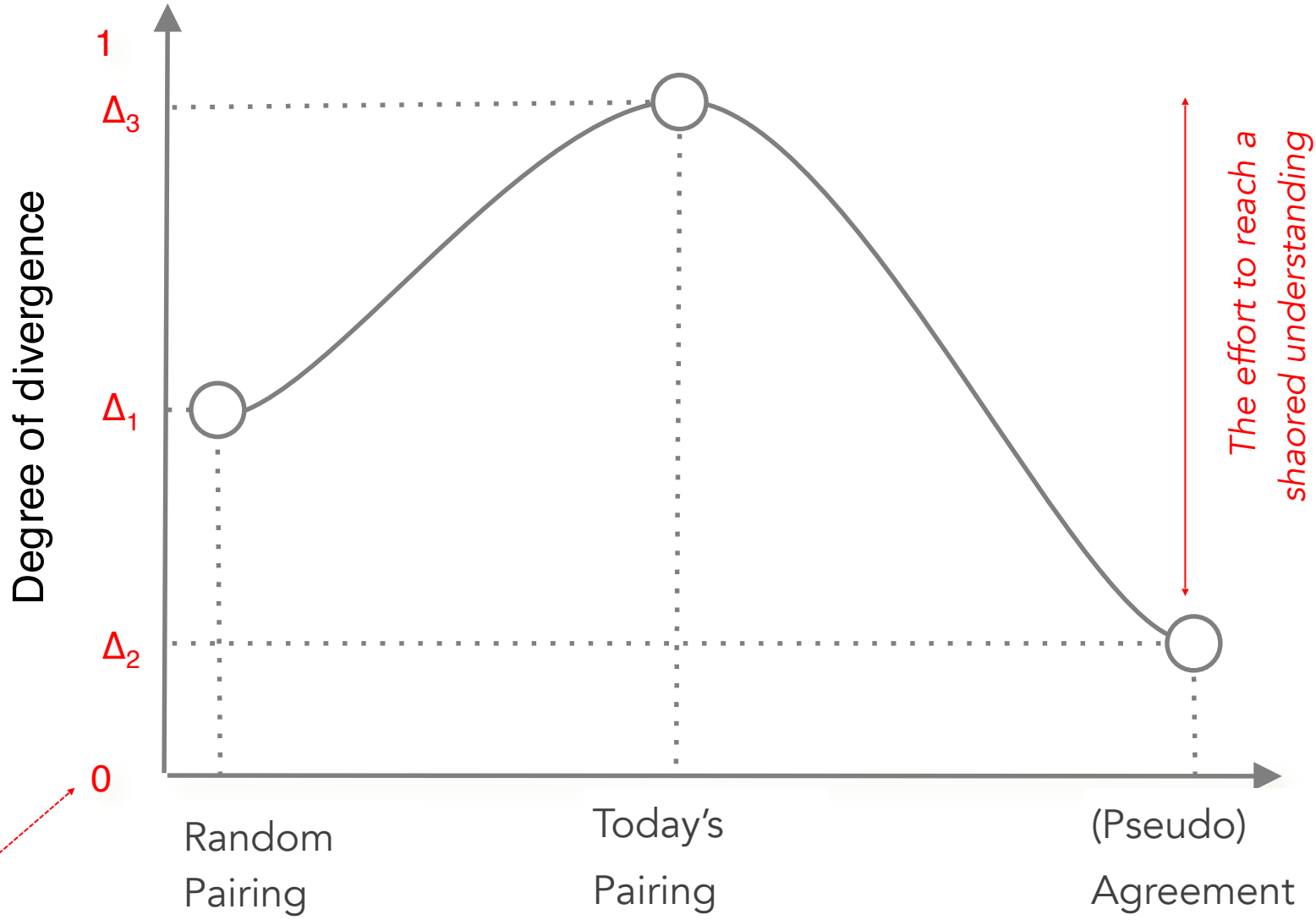
Collaborative learning is not a dogma

Today's lesson:





"Please discuss about the pros and cons of collaborative learning and the role of computers !"



Shared Understanding



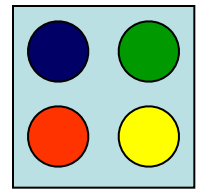
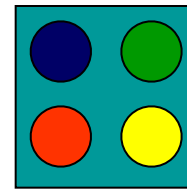
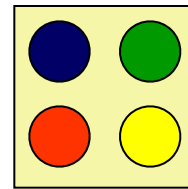
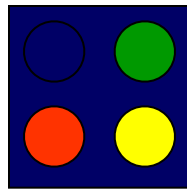
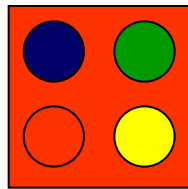
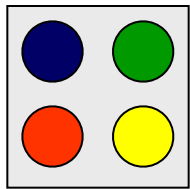
# “Jigsaw”

- Task: How to prevent a large earthquake ?
- Roles:
  - Maire of San Francisco 
  - Insurance agent 
  - Security officer 
  - Geologist 
- Context: Previous experiments in Denver

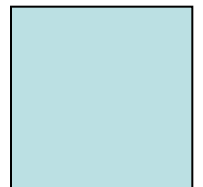
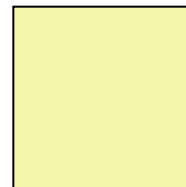
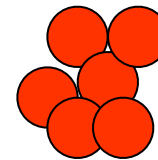
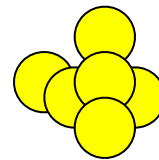
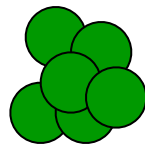
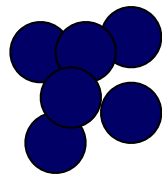
In the Jigsaw script, every team member receives a subset of the information necessary to solve the task. This task cannot be solved without the contribution of each individual.

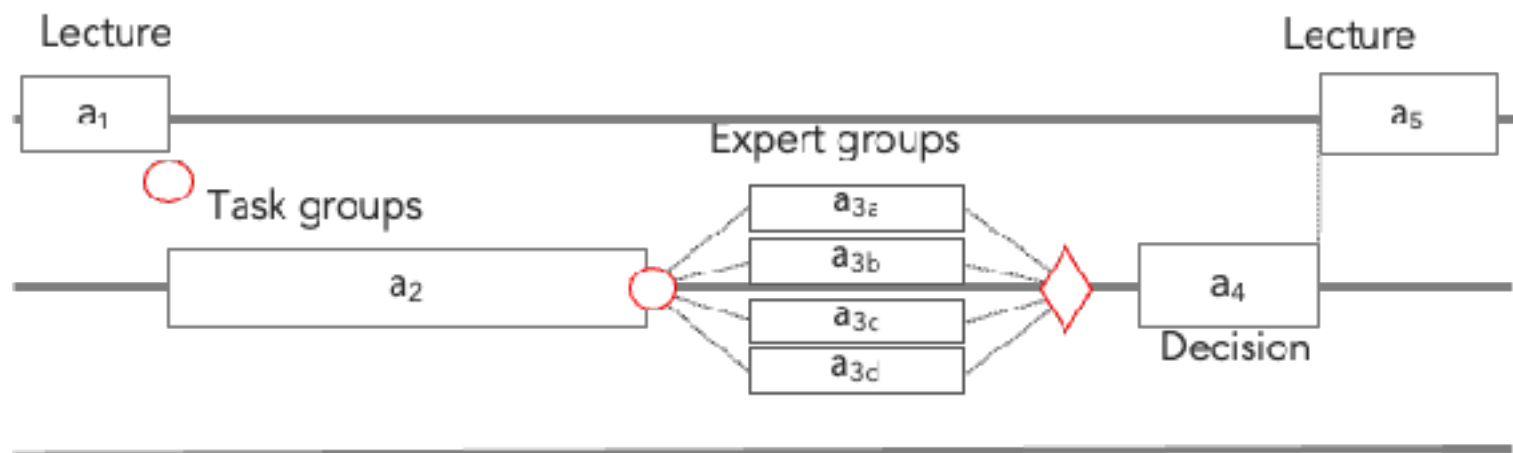
# Jigsaw

## Phase "Groups"



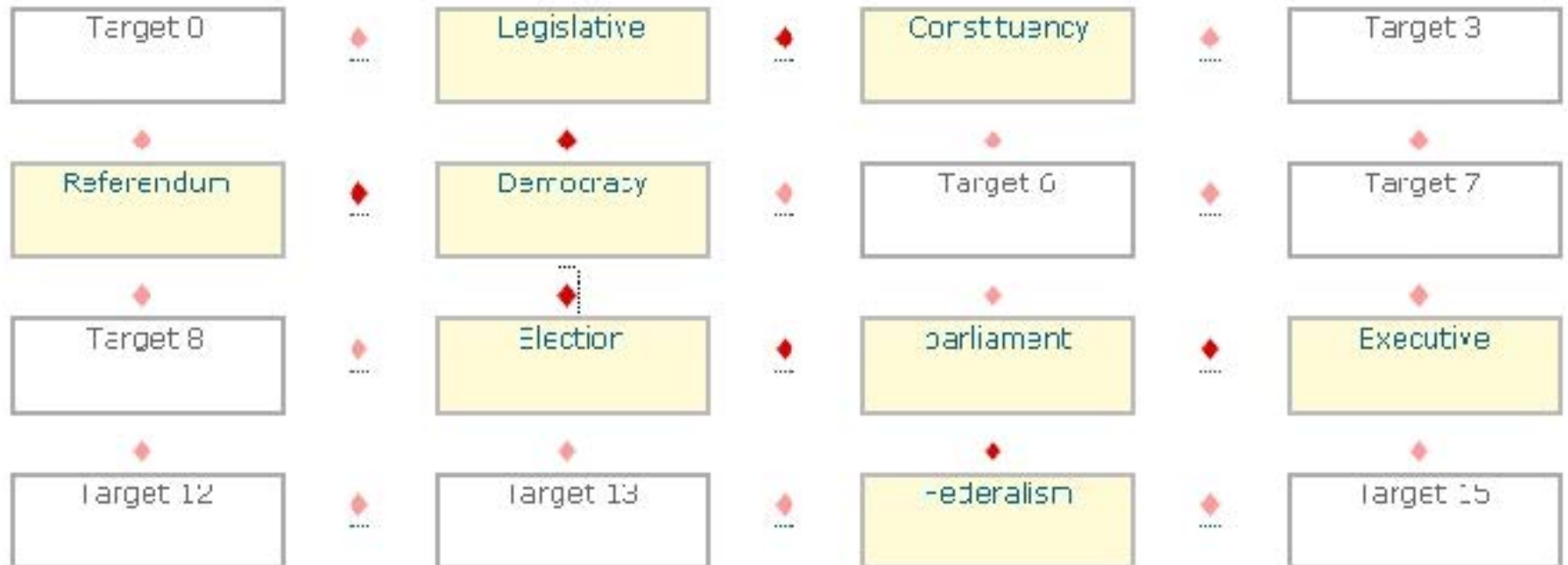
## Phase "Experts"





## Grid

Place the concepts below on this grid then click on the link between two concepts to define their similitude or difference with the help of your group members. You might change the concepts place to define other relations.



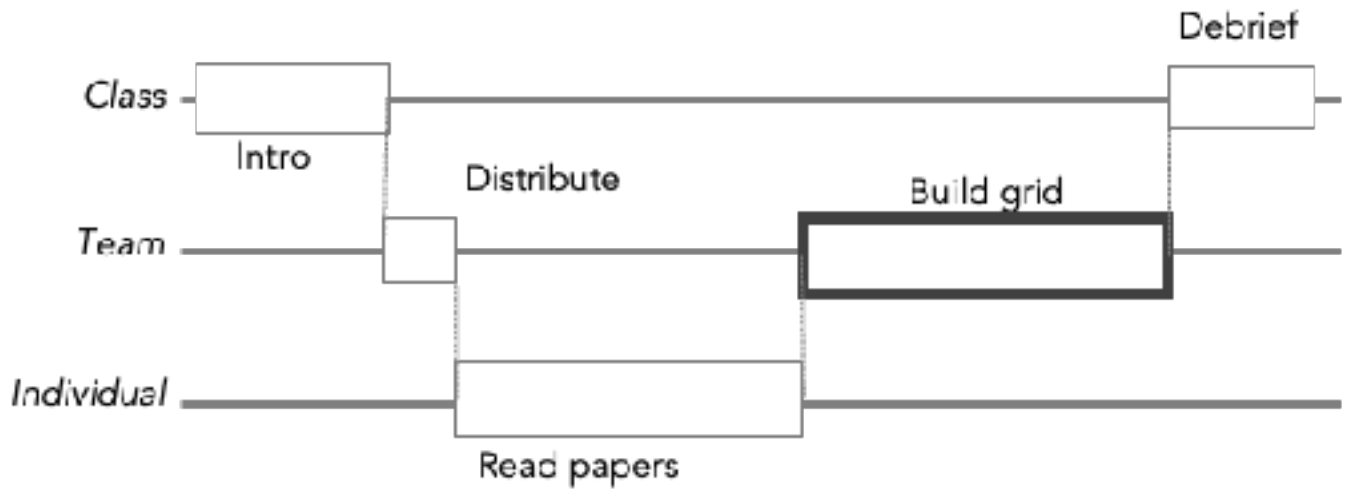
## "Democracy" vs "Election"

Relationship:

Comments: Democracy is a form of government in which it is recognized that ultimate authority belongs to the people, who have the right to participate in the decision-making process called elections, to appoint and dismiss their rulers.

Save

Reset



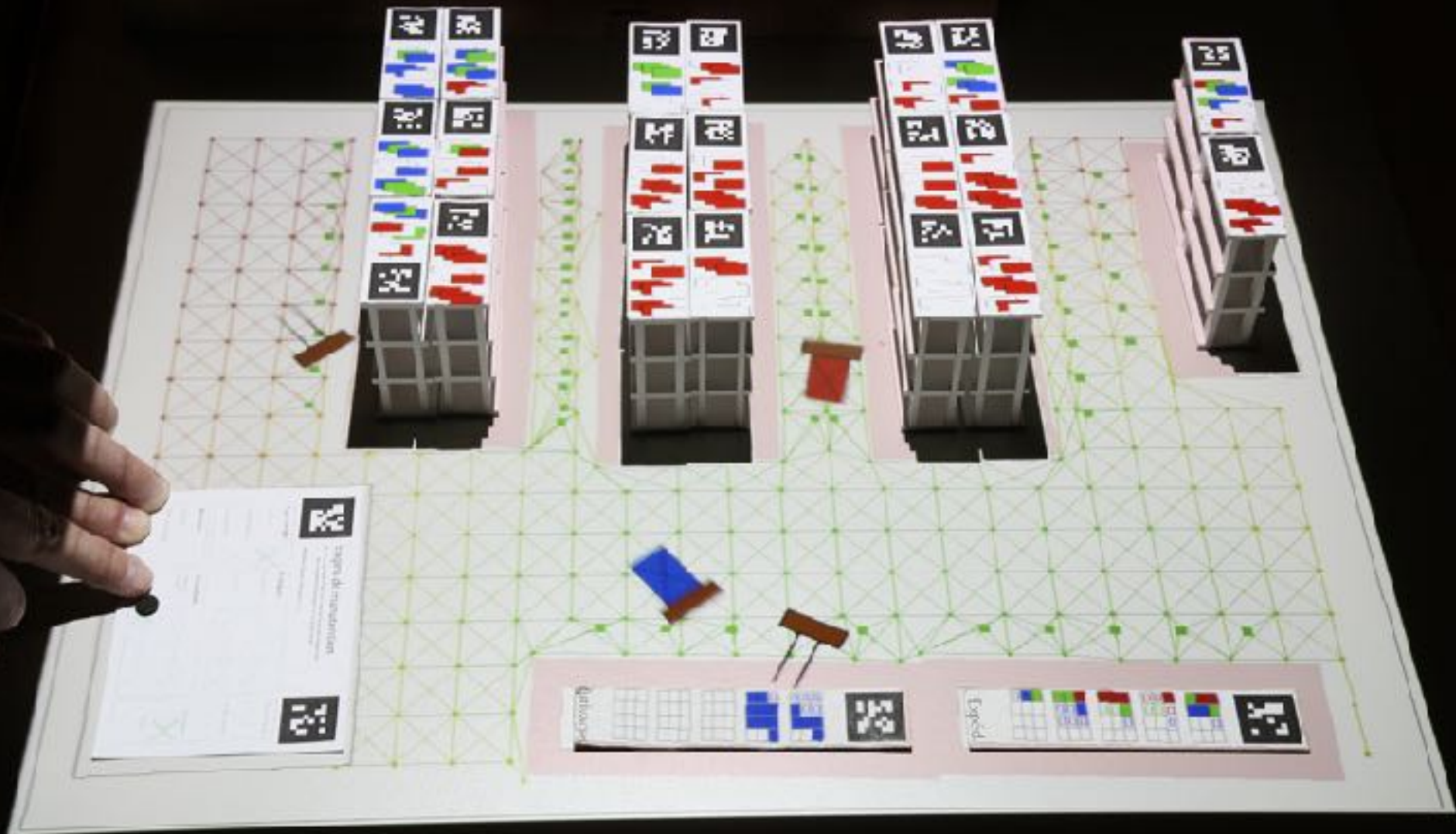
1. Collaborative learning occurs when team members engage into

## rich verbal interactions

These interactions are summarized as “the effort” that team members engaged to reach and maintain a shared understanding of the task.

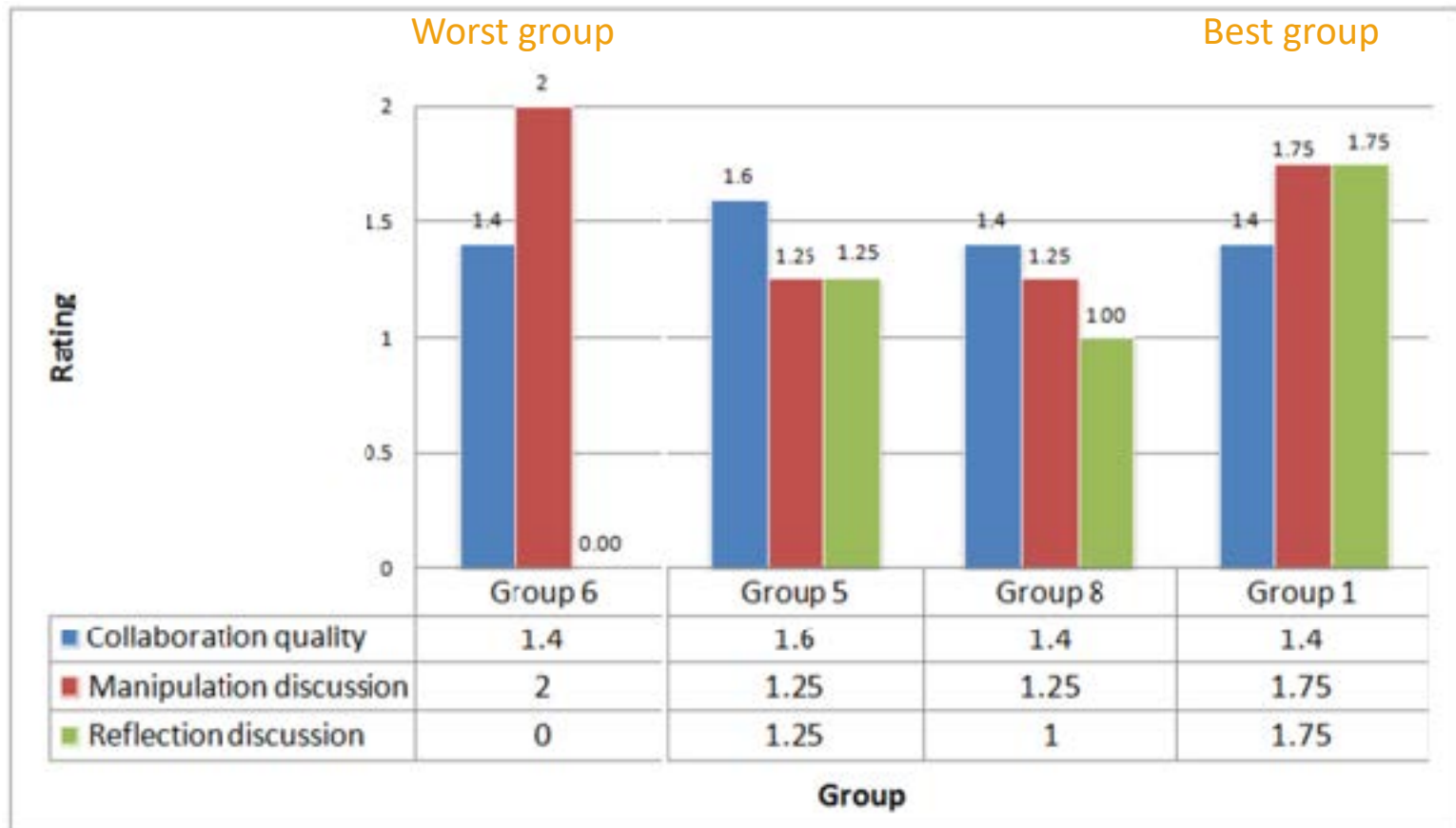
2. Collaborative learning is not a religion. It benefits from being integrated into classroom scenarios that integrate individual, team and class wide activities.

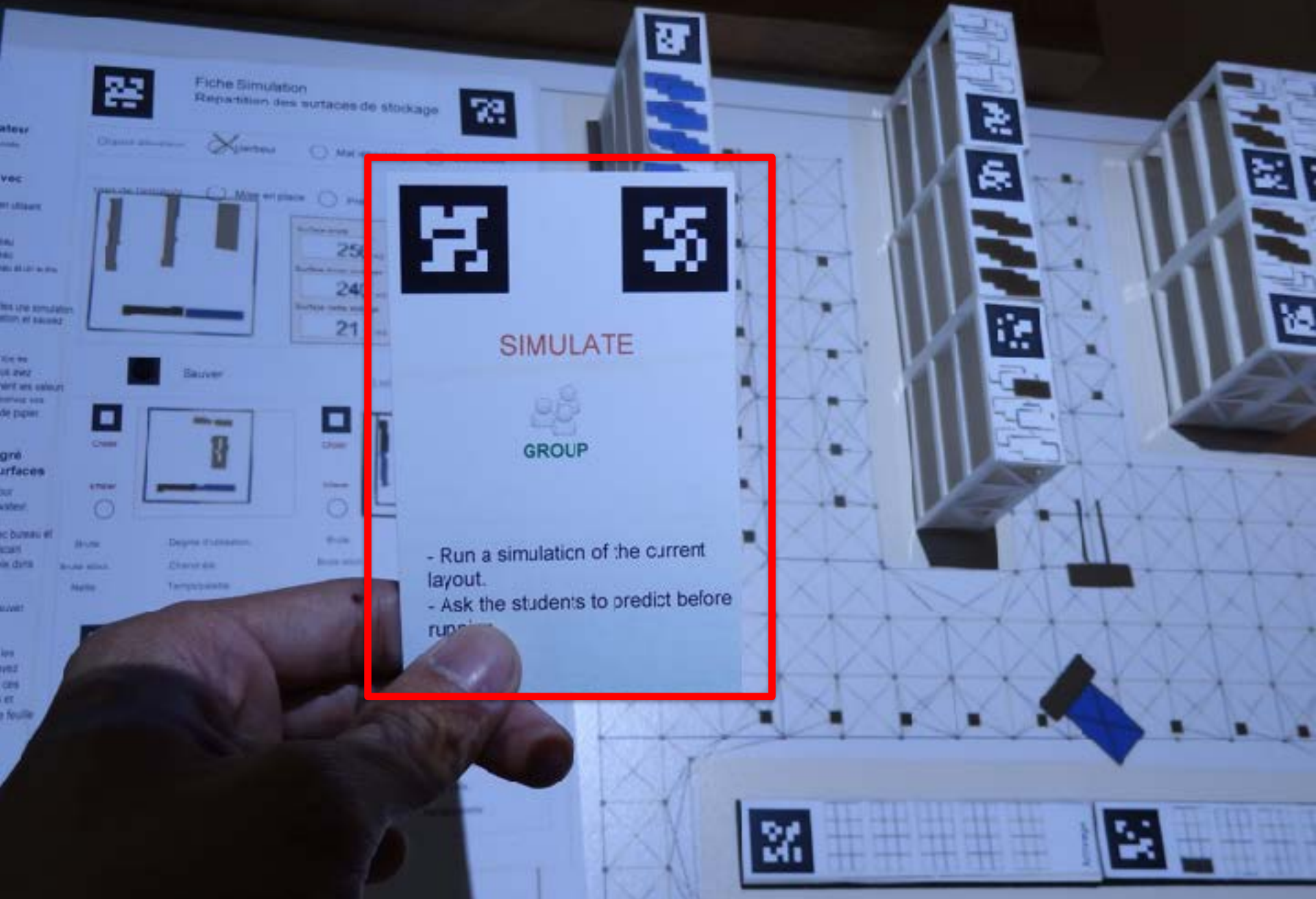
3. It takes talented teachers to orchestrate these scenarios



The TinkerLamp

# "Tentation de manipulation"





Fiche Simulation  
Répartition des surfaces de stockage



SIMULATE



- Run a simulation of the current layout.
- Ask the students to predict before running.

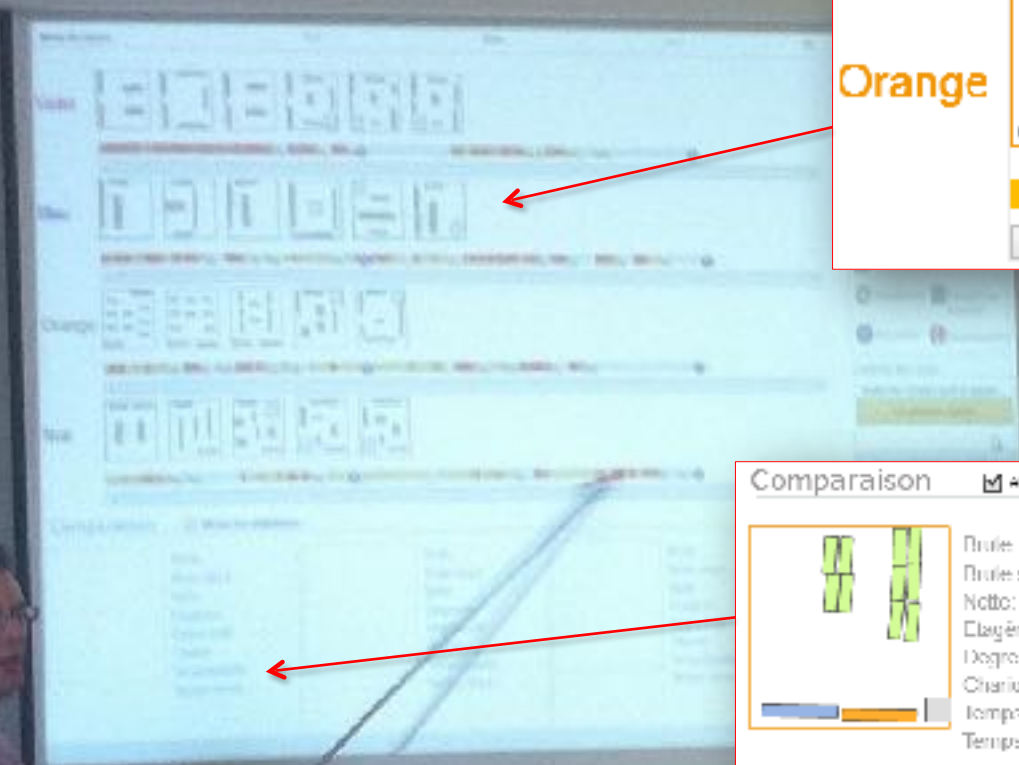


## PAUSE CLASS



CLASS

- Pause all the actions (simulation, building model, etc.) in the whole class



Orange





# Summary of chapter 7

1. Collaborative learning is often effective, but not systematically.
2. Effective tasks require some degree of **interdependence** among team members
3. It is effective when **rich verbal interactions** occur such as explanation, argumentation, mutual regulation
4. To make it more effective, **classroom scripts** increase the probability for students to produce these interactions by **integrating** team, individual and class wide activities
5. It takes a talented **teachers** to orchestrate these scenarios
6. The theory behind emphasizes that **cognition is inherently social** because thinking mostly relies on language.

# How to design activities for people to learn?

## Chapter 3: Constructivism (PS-I)

- *the theory originates from developmental psychology*
- the goal is to reach a deep understanding of the target (declarative) knowledge
- the craft is to design a problem solving activity during which the learners will approximate the concepts
- and then, « there is a time for telling »

individual adaptation

## Chapter 4: Mastery learning (I-PS; I-PS; I-PS; I-PS)

- *the theory originates from behavioral psychology (reinforcement learning)*
- the goal is to build mastery of incrementally more complex (procedural) skills
- the craft is to decompose the skills into
- and then, « there is a time for telling »

verbal interactions

## Chapter 5: Social cognition (PS ...)

- *the theory originates from socio-cultural psychology*
- the goal is to reach a deep understanding of the target (declarative) knowledge
- *the craft is to engage learners in rich verbal elaborations through inter-dependence*
- and then, « there is a time for telling »